DOCUMENT RESUME

ED 240 263 CE 038 009

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TITLE	Agricultural Machinery - Equipment. Agricultural Cooperative Training. Vocational Agricluture. Revised.
INSTITUTION	Texas A and M Univ., College Station. Vocational Instructional Services.
PUB DATE	78
NOTE	508p.
AVAILABLE FROM	Vocational Instructional Services, Texas A and M University, F. E. Box 182, College Station, TX 77843 ($11.90).
PUB TYPE	Guides - Classroom Use - Materials (For Learner) (051) -- Tests/Evaluation Instruments (160)
EDRS PRICE	MF02 Plus Postage. PC Not Available from EDRS.
DESCRIPTORS	*Agricultural Education; *Agricultural Engineering; *Agricultural Machinery; Agricultural Machinery Occupations; Autoinstructional Aids; Behavioral Objectives; *Cooperative Education; Instructional Materials; Learning Activities; Secondary Education; Tests; *Vocational Education

ABSTRACT

Designed for students enrolled in the Agricultural Cooperative Part-Time Training Program, this course of study contains 12 units on agricultural machinery mechanics. Units include (examples of unit topics in parentheses): introduction (agricultural mechanics as an occupation; safety--shop and equipment; use of holding devices, jacks, lifts, and hydraulic presses; use of equipment manuals; and equipment inspection), primary tillage equipment (moldboard plows, disk plows, middlebusters and listers, and chisel plows), secondary tillage equipment (disk and spring-tooth harrows, land rollers and pulverizers, and rotary hoe), planting equipment (grain drills, and row-crop planters), cultivating and weed control equipment (cultivators, flame weeders, and rotary shredders), sprayers and dusters (hydraulic sprayers, pumps for agriculture sprayers, blower sprayers, and dusters), fertilizers (manure spreaders, dry fertilizer distributors, and liquid and gas fertilizer equipment), combines (cutting, feeding, and threshing mechanisms and combine attachments), corn pickers (gathering and snapping mechanisms and husking, cleaning, and shelling mechanisms), cotton strippers and pickers, hay and forage equipment (movers, hay rakes, hay conditioners, and balers), and special equipment (farm elevators, feed mills, crop drying equipment, forage blowers, tractor-mounted loaders, and chain saws). Introductory materials include a course outline and a list of supplementary references. Provided for each unit topic is: an assignment sheet that presents the objective, a list of references, and a list of questions and activities; and information sheets with diagrams and drawings. Other contents include answer sheets for the questions and activities, tests on each topic, and answer sheets for the topic tests. (YLB)

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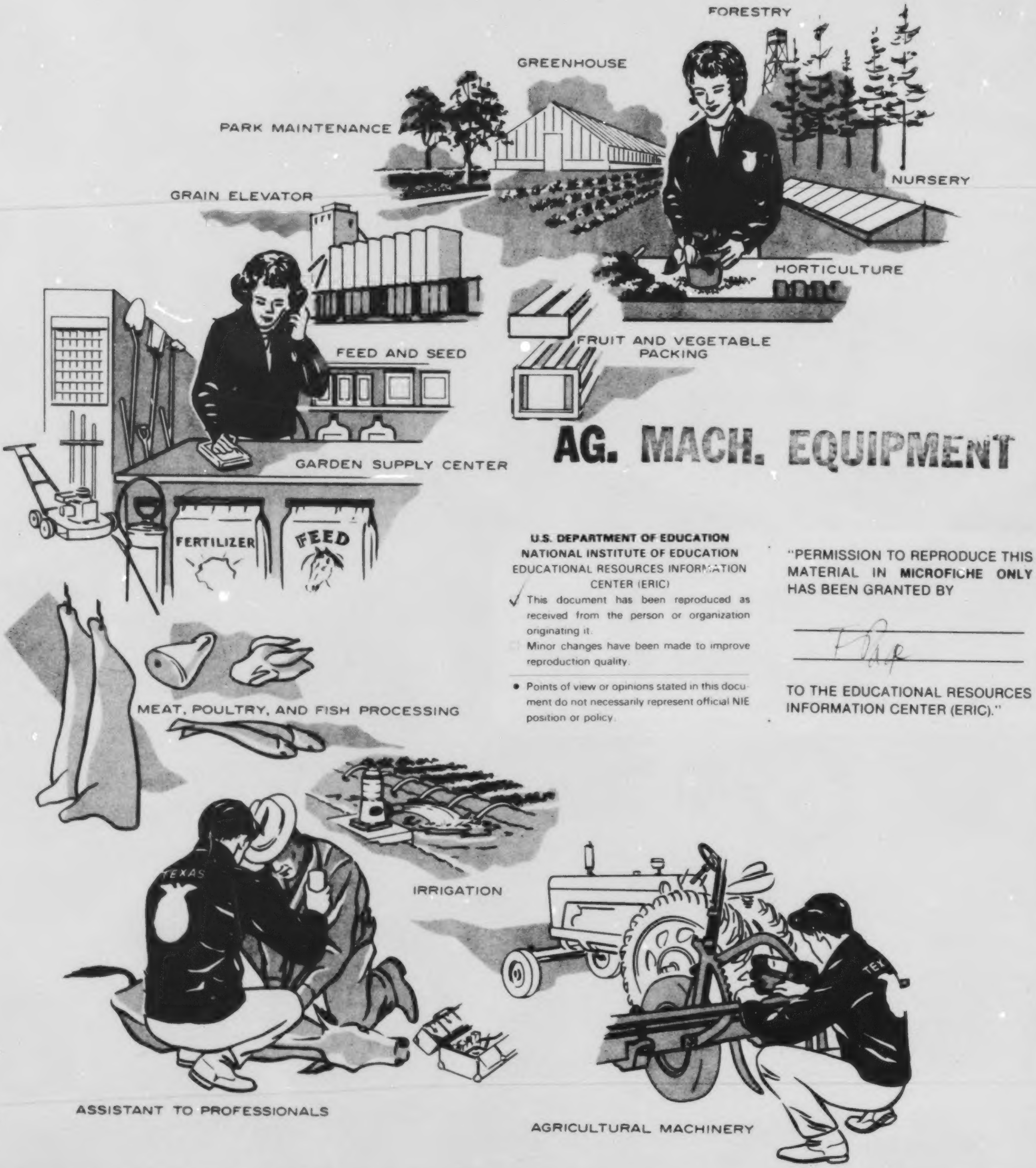
FORESTRY
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FEED AND SEED
FRUIT AND VEGETABLE PACKING
GARDEN SUPPLY CENTER
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AGRICULTURAL MACHINERY

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ACKNOWLEDGEMENT

This course of study, Agricultural Machinery - Equipment, is designed for the student enrolled in the agricultural cooperative part-time training program.

Information for several of the units was taken from the pre-employment laboratory training material "Agricultural Machinery Service and Repair".

The materials in this course of study were compiled by David Sandlin, Graduate Assistant, and Lester F. Buford and Neil K. Overstreet, Subject Matter Specialists, for publication by the Vocational Instructional Services Center. Art work and illustrations were prepared by Charles O. Palmer, Subject Matter Specialist. Editing was done by Gene Hix, Editor.

Foy Page
Coordinator

Revised: 1978

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Vocational Instructional Services
Texas A&M University
College Station, Texas 77843

Course Outline
for
AGRICULTURAL MACHINERY OCCUPATIONS-EQUIPMENT

I. Introduction
    1. The Machinery Industry and its Importance in American Agriculture
    2. Agricultural Mechanics as an Occupation
    3. Safety - Shop and Equipment
    4. Mechanical Tools - Identification and Use
    5. Use of Holding Devices, Jacks, Lifts, and Hydraulic Presses
    6. Use of Equipment Manuals
    7. Equipment Inspection
    8. Fasteners Used on Equipment
    9. The Function and Types of Bearings on Equipment
    10. Gaskets, Seals, and Sealants for Farm Equipment
    11. Painting Equipment and Machines
    12. Importance of Welding and Identification of Metals
    13. Tires and Wheel Rims
    14. Tubing and Hoses

II. Primary Tillage Equipment
    1. Moldboard Plows
    2. Disk Plows
    3. Middlebusters and Listers
    4. Rotary Plows
    5. Chisel Plows and Subsoilers

III. Secondary Tillage Equipment
    1. Disk Harrows
    2. Spring-Tooth Harrows
    3. Spike-Tooth Harrows
    4. Land Rollers and Pulverizers
    5. Rotary Hoe

IV. Planting Equipment
    1. Grain Drills
    2. Row-Crop Planters

V. Cultivating and Weed Control Equipment
    1. Introduction
    2. Cultivators
    3. Flame Weeders
    4. Rotary Shredders

VI. Sprayers and Dusters
   1. Hydraulic Sprayers
   2. Pumps for Agriculture Sprayers
   3. Blower Sprayers
   4. Dusters
   5. Calibrating Spray Equipment

VII. Fertilizers
   1. Manure Spreaders
   2. Dry Fertilizer Distributors
   3. Liquid and Gas Fertilizer Equipment

VIII. Combines
   1. Introduction
   2. Cutting, Feeding, and Threshing Mechanisms
   3. Separating and Cleaning Mechanisms
   4. Grain Handling Unit and Combine Attachments

IX. Corn Pickers
   1. Introduction
   2. Gathering and Snapping Mechanisms
   3. Husking, Cleaning, and Shelling Mechanisms

X. Cotton Strippers and Pickers
   1. Strippers
   2. Pickers

XI. Hay and Forage Equipment
   1. Mowers
   2. Hay Rakes
   3. Hay Conditioners
   4. Windrowers
   5. Balers
   6. Forage Harvesters

XII. Special Equipment
   1. Farm Elevators
   2. Feed Mills
   3. Feed Grinder - Mixers
   4. Post - Hole Diggers
   5. Crop Drying Equipment
   6. Forage Blowers
   7. Tractor-Mounted Loaders
   8. Chain Saws
   9. Feed Distribution Equipment

Supplemental References
for
AGRICULTURAL MACHINERY OCCUPATIONS - EQUIPMENT

*1. "Ball and Roller Bearings," American Association for Vocational Instructional Materials, Engineering Center, Athens, GA.

*2. "Selecting and Storing Tractor Fuels and Lubricants," American Association for Vocational Instructional Materials, Engineering Center, Athens, GA.

*3. Smith, Harris Pearson, Farm Machinery and Equipment, 5th ed., McGraw-Hill Book Company, Dallas, TX, 1964.

*4. Stone, Archie A. and Harold E. Gulvin, Machines for Power Farming, 2nd ed., John Wiley & Sons, Inc., New York, NY, 1967.

*5. "The Tractor Electrical System," American Association for Vocational Instructional Materials, Engineering Center, Athens, GA.

*6. "Tractor Hydraulics," American Association for Vocational Instructional Materials, Engineering Center, Athens, GA.

*7. "Tractor Maintenance, Principles and Procedures," American Association for Vocational Instructional Materials, Engineering Center, Athens, GA.

*8. "Tractor Transmissions," American Association for Vocational Instructional Materials, Engineering Center, Athens, GA.

*9. Fundamentals of Service Shop Tools, Deere and Company, Moline, IL., 1973.

*10. Fundamentals of Service Mowing and Spraying Equipment, Deere and Company, Moline, IL., 1974.

*11. Fundamentals of Machine Operation Machinery Management, Deere and Company, Moline, IL., 1975.

*12. Fundamentals of Machine Operation Combine Harvesting, Deere and Company, Moline, IL., 1973.

*13. Fundamentals of Machine Operation Hay and Forage Harvesting, Deere and Company, Moline, IL., 1976.

*14. Fundamentals of Machine Operation Tillage, Deere and Company, Moline, IL., 1976.

*15. Fundamentals of Machine Operation Planting, Deere and Company, Moline, IL., 1975.

*16. *Fundamentals of Machine Operation Agricultural Machinery Safety*, Deere and Company, Moline, IL., 1974.

+17. Operator's Manuals for:

- Farm Elevators
- Feed Mills
- Feed Grinder-Mixers
- Post-Hole Diggers
- Crop Drying Equipment
- Forage Equipment
- Tractor-Mounted Loaders
- Chain Saws
- Feed Distribution Equipment

* Available from Vocational Instructional Services
+ Available from implement manufacturers

Assignment Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Introduction

TOPIC: The Machinery Industry and Its Importance in American Agriculture

OBJECTIVE: To develop an understanding of the importance of agriculture equipment in the agricultural industry.

REFERENCE:
Information Sheet, "The Machinery Industry and Its Importance in American Agriculture"

QUESTIONS AND ACTIVITIES:

1. During what period did great improvements appear in the development of farm equipment and what type of equipment was developed?
2. List the years that the following equipment was made and used: moldboard plow, reaper, mower, baler, combine or thresher, cultivator, and grain drill.
3. How long was the animal power period?
4. What have been the results of powered equipment, using wheat production as an example?
5. List major food crops and products that are exported to other foreign countries.
6. What are some of the major changes experienced due to farm mechanization?
7. What percent of the farms produce most of the food and fiber?

Information Sheet
on
THE MACHINERY INDUSTRY AND ITS IMPORTANCE IN AMERICAN AGRICULTURE

Great improvements in American agricultural production began in the 1800's with the inventions and patents of soil preparation, planting, cultivating, and harvesting equipment. The major advances were recorded as follows:

1797 - Cast-iron moldboard plow patented.
1822 - Mower and grass cutting machine patented.
1831 - The birth of the reaper which became the forerunner for the binder.
1838 - Two-row corn planter patented.
1840 - First grain drill mechanism patented.
1853 - The stationary hay baler was used.
1863 - First commercial riding cultivator placed on the market.
1864 - Sulky riding plow marketed.

Some other important equipment inventions were: corn picker, 1880; cotton stripper and factory production of combines, 1880. The early plows were developed to be pulled by ox teams. After 1850, horses began to be used extensively for pulling farm equipment. In 1870 each farm worker had only 1.6 horsepower at his command and by 1920, he commanded 5.3 horsepower which was due to working several horses on pieces of equipment or pulling the equipment with tractors. The tractor operated farm may exceed 50 horsepower. Actually tractor power was not used extensively to draw farm equipment until after World War I, even though the first successful tractors were developed between the years of 1901 and 1918.

Until 1850, most farm work was accomplished by hand tools. Animal power came into its own after this period and remained about the same until about 1918. Most of the horse-drawn farm equipment was comparatively simple if compared to tractor drawn or tractor mounted equipment. During the early 1930's tractor manufacturers began mounting equipment on tractors. Before this period tractor equipment was attached to the drawbar. However, some of the most modern equipment is still attached to a drawbar.

Few, if any, industries have the far reaching effect on our national economy and the American Way of Life as the manufacture of farm equipment. Its products have reduced the number of hours required to produce a crop or raise an animal. For example, in 1830, 55.7 man-hours were required to produce 20 bushels of wheat on one acre. By 1916, the total number of man hours to produce the 20 bushels was reduced to 8.8. This reduction was brought about by the use of a horse drawn drill and binder. Less than 1.5 hours are required today to produce the same 20 bushels with modern farm equipment.

The Machinery Industry and Its Importance in American Agriculture
(Information Sheet continued)

Man's oldest enemy, hunger, is continuing to be more realistic as the world becomes more densely populated. The word "famine" was common-place with man until he replaced hand tools with animal drawn equipment to produce grain crops. Even though the United States has experienced no general famine, grain surplus stocks have declined due to exporting grains to foreign countries. Actually grain surplus supplies have declined over the world at a rate of 1.4 percent each year. The cause of the world decline is that consumption has been exceeding production.

Most of the underdeveloped countries of the world import food products (wheat, rice, cotton, dairy products, grain sorghum, corn, soybeans, cooking oils, and many other raw products) because of the following problems:

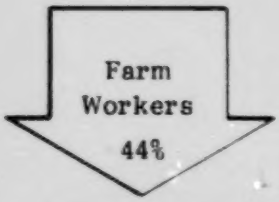
Lack of technical knowledge in agriculture
Lack of farm power machinery and equipment
Failure to control parasites and diseases
Lack of productive soil and adequate amounts of fertilizer
Size of farm governed by the type of equipment used to produce farm products

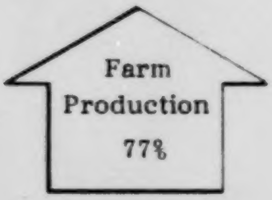
In many of these countries 65 percent of the income comes from farming. Agriculture is considered the only resource in many of the underdeveloped nations. Most of the population in these countries is considered rural. For example, about 90 percent of the African population is rural.

Some changes experienced in the agricultural industry due to farm mechanization are:

Sixty years ago one farmer produced enough food and fiber for himself and six other people. Today one farmer produces food and fiber for himself and at least fifty other people.

Farm workers have decreased in number, yet farm production has increased.





Farms are increasing in size, but the number of farms has decreased in most states. For example, 40 percent of the farms produce about 87 percent of the food and fiber sold from the farm.

The Machinery Industry and Its Importance in American Agriculture
(Information Sheet continued)

> Today's farmers have better educational opportunities, more time for recreation, more home conveniences, and better facilities and equipment than farmers had at the beginning of the twentieth century.
>
> Farm business is considered big business. Agriculture is one of the largest industries in the United States.

The American farmer is the supervisor of energy and not its source. He makes use of mechanical energy instead of producing energy to do farm work. The farmer's productive power is multiplied many times through the use of modern farm equipment.

Assignment Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Introduction

TOPIC: Agricultural Mechanics as an Occupation

OBJECTIVE: To develop an understanding of the opportunities for an equipment mechanic or repairman in the agricultural machinery industry.

REFERENCES:
Information Sheet, "Agricultural Mechanics as an Occupation"

QUESTIONS AND ACTIVITIES:

1. Briefly explain the need for equipment technicians.
2. List the number of manufacturing plants, the number of dealerships, and the number of people employed in dealerships.
3. If the average dealership sales and services total $450,000 and one-third is gross income from service, parts, and supplies, what is the income from sales?
4. What are considered skilled jobs in the equipment industry?
5. List the semi-skilled jobs in the dealerships.
6. Why is it important that the equipment technician have an adequate education?
7. Who is usually the supervisor of a repairman in a dealership and where does the repairman work?

Information Sheet
on
AGRICULTURAL MECHANICS AS AN OCCUPATION

Science and modern technology in agriculture have increased the demand for knowledge and skilled agricultural technicians to manufacture, distribute, and service agricultural machinery in the entire agricultural industry.

Specialized machines and equipment are used to accelerate food and fiber production for the nation's expanding population. Agricultural mechanical power for land preparation, planting, cultivating, spraying, harvesting, transporting, and processing has more than doubled the output per man hour since 1950.

Farm machines represent a major capital investment for the American farmer. Industry is concerned about recruiting qualified young men to supply, operate, and service these machines. It is estimated that several thousand skilled agricultural equipment technicians are needed annually by manufacturers, distributors, and farm machinery service and repair businesses.

The agricultural machinery industry continues to look to schools for helping meet their occupational needs. Industry's requirement needs for technicians are divided into the following three categories:

Present need
Retirement replacement need
Future expansion need

There are about 80,000 people employed in the 16,000 agricultural dealerships in the United States. Most of these dealerships sell many types of equipment and supplies and service the equipment they sell. The 16,000 dealers are supplied agricultural equipment, parts, and supplies by 955 manufacturing plants. Eight major plants furnish supplies to over 50 percent of all manufacturered products. Most dealers have invested over $100,000 and may average $450,000 from sales and services. About one-third of the gross earnings are from service, parts, and supplies.

The types of employment in the equipment industry are:

Skilled: Mechanic, partsman, welder, bodyman, machinist, assistant partsman, welder-repairman, and welder-painter.

Semi-Skilled: Assemblyman, shop worker, deliveryman, set-up and deliveryman, mechanics helper, pick-up man, and welder's helper.

In order to perform the job as a welder and general repairman it is necessary that the mechanic helper be skilled in the following jobs: replace or repair damaged parts that may require heating, tempering, drilling, grinding, and/or bending and cutting metals; replace or repair gears and/or bearings; recondition old metals for painting; and paint equipment parts. Any skilled mechanic has the ability to use tools and equipment properly to perform reconditioning jobs on equipment. Mechanical aptitude, interest, and education are assets to a good mechanic or repairman.

Most machinery mechanics or repairmen have entered the profession as a mechanic's helper. Usually the helper has had some background training before becoming a helper. A farm machinery service center employs a skilled mechanic who is a specialist in the machinery handled by the service center.

A good repairman may do repair jobs and supervise repair jobs such as overhauling equipment. The farm machinery repairman must also know how to repair farm machines such as cotton pickers, combines, planters, plows, sprayers, cultivators, baling equipment, forage harvesters, and various types of mowers. In large machinery centers the mechanics usually specialize in one or two areas. For example, a mechanic may be a specialist in welding, sharpening tools, general reconditioning, or a mechanic may be a power train specialist, which may involve hydraulics.

A mechanic's helper's duties and responsibilities may be somewhat different from the mechanic's responsibilities. The helper may enter the profession by doing some of the following jobs: clean machinery that is to be repaired by using solvents and steam, disassemble machinery to be repaired, paint machinery, assist the mechanic on repair jobs, clean the mechanic's tools and equipment, and clean the shop.

Farm power advancement will continue to demand technicians that have a working knowledge of all types of farm machinery. It is also important that the mechanic have an adequate education. Agricultural machinery manufacturers provide service manuals for power machinery and all types of equipment; therefore, a good mechanic must be able to read and understand the service manuals.

A farm equipment repairman works under the supervision of the service department. Service jobs are performed both in the field and in the service shop. The organizational structure of a local agricultural machinery dealership is as follows:

AGRICULTURAL MACHINERY DEALER
Assistant Manager

Sales	Clerical	Parts	Service
Sales Supervisor Salesman	Office Supervisor Bookkeeper	Parts Supervisor Parts Man	Service Supervisor or Manager Set-Up Man Mechanic's or Repairman Helper Deliveryman

Assignment Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Introduction

TOPIC: Safety - Shop and Equipment

OBJECTIVE: To learn and observe shop and equipment safety practices.

REFERENCES:
Information Sheet, "Safety - Shop and Equipment"

QUESTIONS AND ACTIVITIES:

1. What percent of the accidents are caused by carelessness and what percent are caused by faulty equipment?
2. Why are shop safety rules so important?
3. List the number of disabling injuries in industry each year, and the number recorded in the agricultural industry.
4. What does the electrician's education include regarding safety?
5. List at least five good housekeeping practices used in a shop safety program.
6. List protective devices used by a welder.
7. List ten behavior practices that may cause a shop to be unsafe.
8. In what ways can hand tools cause injury?
9. List five precautions to observe when using power tools.

Information Sheet
on
SAFETY - SHOP AND EQUIPMENT

Most accidents are caused by carelessness. Surveys on what causes accidents resulted in the following information: Eighty-six to eighty-eight percent are caused by human carelessness, faulty equipment causes ten percent, and unavoidable happenings (lightning) cause two to four percent. Someone has made this statement, "Most accidents don't just happen, they are caused by human error."

If one of the objectives of the machinery service and repair shop is to improve mechanical skills, then it is necessary that standards be developed and observed in order to support a good mechanics program.

Good Training Programs - These programs are based upon safety standards which are partially supported by rules and regulations. A service and repair shop is no exception. There must be rules in a shop program. Good habits are developed by conforming to good rules. The purposes of shop rules are:

To protect the employee while he is performing a job.
To protect expensive equipment and hand tools.
To keep tools and equipment available for shop work.
To perform a good job by using the tools and equipment properly.
To learn to respect properly conditioned tools and equipment and good workmanship.
To develop skills by servicing and repairing farm machinery and equipment.
To develop a shop type of behavior.
To learn to appreciate the value of good housekeeping practices.
To prepare and keep good shop notebooks.
To have a complete understanding of the purpose of the agricultural mechanics program.

Shop Safety - Safety rules are made to protect the employee; in so doing, they protect the tools, equipment, and building. For example, if the shop worker fails to use the blacksmith's hammer on a cold chisel, and instead uses a claw hammer and pieces of the face break off, hitting him in the face or shattering a window, then shop safety is not observed. Use of the shop tools, equipment, and building - The purpose of the shop is to give service to the customer; therefore, tools and equipment should be used properly at all times.

Shop Behavior - Scuffling or horseplay endangers not only the employee in the act, but all other people in the shop. Loud conversation is distracting in any place, especially in the shop area. It is too distracting to be tolerated in either the shop or working area. Walking, instead of running in the shop, is considered a must in shop rules. Talking to a employee who is working with tools or equipment may distract him from his work and create an accident or injury. The employee should use only those tools and equipment approved by the supervisor.

Use Good Housekeeping Practices - The shop must be kept clean and the equipment and tools should remain in an orderly condition even when in use. A clean shop will have the following characteristics:

Clean floors
Tools in their proper places
Waste materials removed
Work benches clear of waste materials
Supplies and materials in the proper place

In a recent year, the agricultural industry lead all other industries with the largest number of deaths and injuries caused by accidents. Agricultural machinery was the major source of the recorded accidents. There are about 2,000,000 disabling injuries each year in all the major industries, and about 290,000 of those are in the agriculture industry.

Everyone hopes to live a life free of accidents and illness. Industry today wants safe and efficient employees. It wants employees who can advance in their work. If the employee receives a permanent injury, there may be a reduction in the earning power due to the skilled worker becoming an unskilled worker. The family standard of living may be lowered, and the injured employee may need to go through a retraining program. Many people endure this type of experience each year.

When visiting a grain elevator, cotton gin, oil mill, fertilizer factory, oil refinery, textile mill, machinery repair shop, machine shop, paint factory, or feed mill, the employee will see signs and warning signals that direct his attention to danger areas. The signs may be in the form of color codes and the signals only a flashing light. Many of the danger zones have warnings for the benefit of the employee, because the employer realizes that accidents are a preventable waste.

The employee may not be like the safe electrician who automatically keeps his tools in good condition, knows exactly how to install wires and fixtures without endangering himself and others, knows about the dangers of electricity, and has a complete knowledge of the field of work. The electrician's entire training program has caused him to develop an attitude of safety. So, the electrician's education includes habits, skills, knowledge, and attitude favorable to safe work.

The employee must become safety conscious if he is to develop safety habits. If he knows the way he is doing something is dangerous, a positive safety attitude may eliminate an accident. He can stop and change the method to a safer way.

Safety - Shop and Equipment
(Information Sheet continued)

If rules and regulations are followed there will be little or no danger of having a shop accident. One of the first rules in a machinery shop is to observe all shop safety rules. If the safety rules are not observed, accidents will happen. For example, a factory supervisor became lax and permitted his personnel to work without goggles; within one month eye injuries went up five percent. Rules are enforced to protect the employee.

Use of Protective Devices - Eye protection is inexpensive, and good eyesight is priceless. Some injuries may be as slight as a scratch; yet, others may be permanent. Safety devices and their uses include:

Goggles - When welding, grinding, drilling, or chipping certain objects, using a wire brush, and handling certain chemicals, goggles should be worn.

Protective Clothing - Clothing should be free of flammable materials, pockets, and ragged ends when welding. Also, the sleeves and collar should be buttoned. High-topped shoes may eliminate burns from slag or sparks created by the welder. Loose clothing, shirt tails out of trousers, long sleeves, and ties are shop hazards when using power tools.

Gloves - Hand pads or gloves are necessary when handling sharp, heavy, hot, or rough materials around a shop. When welding, fire resistant gauntlet gloves must be used to protect the hands and wrists from burns.

Welding Helmet - A welding helmet is absolutely necessary for protecting the eyes and face from arc rays and splattering hot metal particles.

Respirator - Respirators are used to protect the individual from inhaling paints and their ingredients when spray-painting.

One reckless employee can make the entire shop unsafe. The reckless shop worker should be considered in the same light as a reckless driver; that is, he is failing to consider his safety and the safety of his fellow man. Good citizenship is regarded very highly in the shop.

There are several methods the employee can use to properly handle and place materials in the shop. Heavy objects in farm machinery work should be handled by blocks or block and tackle, suspended from an A-frame or other well-supported structure. To lift a heavy object by hand, use the following procedure:

Safety - Shop and Equipment
(Information Sheet continued)

Use the legs to avoid back and abdominal injuries.
The feet should be kept apart, knees bent, and the back straight as the load is lifted with the legs.
The load is lowered to the floor in the same method as lifting except the knees are bent downward.
While carrying a load, the hands and body should not be shifted to another position.
If the load is heavy, ask for help.
Rough materials and metal should be handled with gloves.

Materials should be placed in a place that is a safe distance from aisles, working areas, and entrances. Machinery parts should be stacked in such a way that the pieces or parts will not strike anyone in the working area. More than 25 percent of all disabilities are caused by the improper handling of materials.

Safety colors have been adopted by many mechanics shops as a safety practice. The shop becomes a safer place to work after the worker learns the meaning of the colors. The color code is universal in that it includes the same safety colors for all factories, shops, and agriculture. There are seven colors that are commonly used in the color dynamics program. They include:

Red - This color indicates the location and the equipment to extinguish fires. The exits are red.

Orange - Orange means danger. It refers to moving parts. Power tool guards, belt guards, cutting edges, and the inside doors of fuse and switch boxes are painted orange to designate the location of dangerous parts.

Yellow- The color yellow designates caution as applied to operating wheels, levers, and other controls. It is used to mark aisles, handrails, equipment locations, and hazardous places that may cause falling.

Yellow and Black - These colors point out obstructions or parts of shop equipment that may endanger the individual if he falls against it.

Green - The color light green is found on the body and base of power tools such as grinders, drill presses, and work benches.

Ivory - This color is used for tops and edges of work benches, insides of cabinets, and non-movable edges of power equipment.

Green - Safety green is a color to mark first-aid equipment. It is used on first aid cabinets in the shop.

Fire Prevention and Fire Fighting - Most fires in the shop are the result of thoughtlessness of an individual. In reality, almost all accidents in the shop are caused by thoughtlessness. Fire prevention and control practices include:

Locate the fire extinguisher stations and identify the type to use on certain types of fires.

If a fire blanket is available, know how to use it to extinguish clothing fires.

Dispose of all flammable objects such as oily rags, scrap materials, and shavings.

Check the location of flammable materials (paints, varnish, lacquer, and paint thinners) before igniting acetylene torch or turning on welder. Gasoline should not be used in the shop.

Store paint, lacquer, paint thinner, and other flammables in a metal cabinet in the shop.

Flammable liquids should never be poured down drains. Such materials create dangers in sewer lines.

There are many solvents much safer than gasoline; therefore, these should be used for cleaning purposes in the place of gasoline.

Many serious accidents have been caused by welding on or cutting on containers which held flammable materials. Such containers should be filled with water and the space above the water level should be vented. An empty gasoline tank may be more dangerous than a full tank. The gasoline vapor remains after the gasoline has been removed.

Hand Tools - Over one-fourth of all shop injuries are caused by the use of hand tools. The injuries stem from five principal causes:

Improper handling of the tools
Using the wrong tool for the job
Using damaged tools
Using dull edged tools
Using greasy or dirty tools

Precautions to observe when using hand tools are as follows:

A dull tool may slide or stick to the material and cause an injury; therefore, cutting tools should be kept sharp.

Safety - Shop and Equipment
(Information Sheet continued)

Tools with mushroom heads (cold chisel with spreading head) are dangerous. A chip may break off, striking any part of the body. Splintered, broken, or loose tool handles can also cause flying objects.

A screwdriver is not to be used as a cold chisel, pry bar, paint paddle, or punch. Each tool is made for a specific job or jobs, and if the job is to be done safely and quickly, the proper tool should be used. Use the proper sized tool for the job.

No tool should be allowed to lie around. Tools should remain in their proper places when not in use, and the sharp edges of cutting tools should be protected.

Tools are never to be carried in the pocket. Sharp or pointed tools are very dangerous in any pocket on the body. A tool box or tool kit and belt tool holders are safe carriers.

Badly worn tools are dangerous, especially pliers and wrenches with jaws. Using a hammer to strike a wrench handle or extended handle to gain more pressure is not a safe practice. Improper sized wrenches may slip on bolt nuts and cause injury to the knuckles. Adjust the jaws of adjustable wrenches so they will not slip.

Greasy or dirty tools are difficult to handle properly. Clean tools make the work more efficient. Tools should be cleaned before they are put on the tool rack.

Tools that have tang handles should be provided with a slip over the handle to protect the hand. For example, a file is dangerous if used without a handle to cover the tang.

Precautions to observe when using portable electric power hand tools include:

Check the tool before using. The three-prong plug (one of the prongs is for grounding the tool) should be free of damage.

Keep the cord out of the aisles or other traveled areas and protect it from hot or rough surfaces, oils, and chemicals.

The hands should be dry when using a power tool. Dry hands may reduce shock effect if there is an improper ground or short in the tool.

Always remove the cord and plug from the outlet by grasping the plug instead of grasping the cord.

Safety - Shop and Equipment
(Information Sheet continued)

The tool should remain on a shelf or rack when not in use. The cord should be rolled loosely when storing the tool.

NOTE: Hand power tools should be used by experienced employees, those that have been instructed in safe methods of using them.

Precautions to observe while working with electricity or electrical equipment include:

Locate and check the use of the master and other switches in the shop.

All electrical tools should be checked for damaged parts, plugs, cords, and ground prongs or wires before using on any job. Sparking or smoking of a motor is a sign to disconnect the equipment and report the condition.

Extension cords should be of a size adequate to handle the electrical load. Exposed wires, faulty plugs, and worn insulation are dangerous signs on extension cords. They should not be placed in aisles or pulled over sharp edges. Cords should be protected from damage by the power tool. They should be disconnected by pulling the plug from the outlet.

Electric portable tools should not be used on damp floors or with wet hands. Rubber soled shoes are the safest to wear when handling electrical equipment.

When fuses blow, there is an indication of an overload or a short. A supply of proper sized fuses should be kept on hand.

When cleaning electrical tools, the proper solvent should be used. Gasoline is very flammable and should not be used.

NOTE: An electrician considers all wires as live wires until proven to be different. Bare fingers are not used to check whether a circuit is energized or not. The control switch is locked open if work is required on the circuit.

Special shop hazards to look out for include:

Chemicals (acids and caustics) should be used under the direct supervision of someone who is acquainted with their proper use and dangers.

Safety - Shop and Equipment
(Information Sheet continued)

Compressed air is very dangerous, and it should be used with caution when painting and cleaning clothing and equipment. It should never be used under the following conditions:

Pointing nozzle at the body as a prank; it can damage the eyes and ears very easily.

Kinking the line to cut off the air or reduce the air flow through the hose.

Cleaning equipment where metal waste is located without protecting the eyes.

When the pressure is too high for the job being done

To remove liquid from surfaces

Minor injuries, such as cuts, bruises, scratches, burns, or punctures, should be treated immediately. The shop first-aid kit may be a handy device to treat minor injuries. The employee should report minor injuries to the shop supervisor.

Major injuries, such as severe shock, scalds, burns, cuts, and broken bones, should be handled immediately by qualified personnel and a physician. First-aid is administered before the employee is sent to the hospital only if advised by the employer; otherwise, the placing of splints, applying a tourniquet, or administering artificial respiration should not be a general practice by the employee.

The best guide to follow to operate a machine properly is the operator's manual. The best type of safety device is the operator. The operator's manual warns against unsafe habits and explains how the operator may develop safe practices. Each year new safety devices are designed and installed on machinery to protect the operator and others. If these devices are removed or made inoperable, the chances of being injured become greater. An agricultural equipment employee (repairman) may be asked to operate machines and equipment around the shop area; therefore, the employee must know how to safely handle different makes and models of machinery.

Assignment Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Introduction

TOPIC: Mechanical Tools - Identification and Use

OBJECTIVE: To be able to identify and understand the use of basic and special mechanical tools.

REFERENCES:
Information Sheet, "Mechanical Tools - Identification and Use"

QUESTIONS AND ACTIVITIES:

1. What are the most common screw-head designs?
2. What are the main uses of pliers?
3. List four common types of hammers.
4. List the different file cuts and describe file teeth to make these cuts.
5. How can cold chisels be used when repairing equipment?
6. Describe the use of the following punches: starting, pin, center, and aligning.
7. What are the purposes of taps and dies in equipment repair work?
8. What common sizes of twist drills are recommended for a mechanical shop?
9. Describe the uses of the following types of pullers: external, press, internal, and stud.
10. Discuss briefly the common types of wrenches used in the repair of equipment.
11. List the most important measuring tools found in the repair shop.

Information Sheet
on
MECHANICAL TOOLS - IDENTIFICATION AND USE

It is advisable to purchase the better quality of mechanic tools for use in the shop. A good quality tool is easier to keep in good condition than a poor quality tool.

All hand tools are made for a specific type of work; therefore, the proper tool should be used for the job, and it should be used in the proper way. The improper use of tools may result in an injury or damage to a piece of equipment and the tool.

Another good practice in the use of tools is to keep them in the proper location when not in use. A tool is more serviceable if it can be found immediately when it is needed. It will likely remain in a better condition if placed in a drawer or a rack while not in use.

The identification and use of some of the most common mechanic shop hand tools is explained below. The masters on the use of these tools are at the end of the discussion in this lesson.

Screwdriver - When using screwdrivers, select the right type and size. The screwdriver is not a prying bar, punch, or cold chisel. The tip should fit the slot of a screw. The standard tip screwdriver may be kept in shape by grinding it to the original shape. Screwdrivers are made for certain types of screw-head designs. The most common are: standard, phillips, clutch, offset, and starting.

Pliers - Pliers are used for holding small parts, crimping connections, cutting wire, bending cotter pins, and doing other useful jobs. Pliers are not made to loosen and tighten nuts. The most common types of pliers are:

Combination - Used for holding work.

Diagonal Cutter - Used for pulling and spreading cotter pins. They may be used to cut soft small gauge wire.

Side Cutter - Used for cutting large gauge wire.

Needle Nose - Used for handling small objects and reaching into close areas.

Snap Ring - Used to replace snap rings.

Lock Grip - Designed to clamp and hold a round object. May be used on nuts where marring is not a problem.

Other Types - Battery, water pump, ignition, brake spring, and hose clamp.

Hammers - When using a hammer, grasp the handle near the end. This position will give more leverage for a harder blow and will help guide the hammer to the object being hit. Deliver the blows by putting the shoulder, elbow, and wrist into the action.

Common types of hammers used in machine shops are:

Ball Peen Hammer - The face of this hammer is used for hammering; the ball is used for riveting and other special jobs.

Soft Hammers - These hammers are softer than the metal they come in contact with; therefore, they are made of plastic, rawhide, brass, rubber, and lead.

Sledge Hammer - The sledge hammer is made of steel. It is used for heavy hammering.

Blacksmith's Hammer - This hammer is used for light-to-medium metal work. It is light enough to be used as a one-hand tool.

Files - Each type of file is made for a specific filing operation. Normally the file is pushed across the work, cutting only on the forward stroke. It is raised on the backward stroke to avoid damaging the cutting edges. The file is used to smooth metal surfaces, sharpen tools, and cut metal to a desired dimension.

Files may be classified by the following characteristics:

Length - A file is purchased by its length in inches. The length is the span between the heel and the tip.

Shape - The most common file shapes are: flat, mill, round, and triangular. Other shapes are: knife, half round, slitting, pillar, and square.

Cuts - File cuts are:
  Single Cut - One row of teeth on blade.
  Double Cut - Two row of teeth on blade.
  Rasp Cut - Independent teeth.
  Curved Tooth - Single row of teeth on the blade in a curve. This type of file is used for aluminum and steel sheet metal.

Grades of Coarseness - The six grades of coarseness include:
  Rough
  Coarse
  Bastard
  Second Cut
  Smooth
  Dead - Smooth

Chisels and Punches - Cold chisels are used for cutting off rivet heads, cutting off bolts, and splitting nuts and cutting thin metal. A punch is used to drive bolts and rivets from holes and to enlarge holes. A chisel or punch should be held as near the top as possible, between the thumb and first two fingers. Wear goggles when using either the punch or chisel. The types of chisels are:

Flat Cold Chisel - This chisel is used for most cutting jobs.

Special Cold Chisels - The three most common special cold chisels are:
Diamond Point - This chisel is used to cut V-grooves and square corners.
Cape - Cape chisels can be used for making grooves in metal and for cutting square corners and keyways.
Round Nose - This chisel can be used to chip inside holes and corners and for cutting semi-circular grooves.

The most common types of punches used are:

Starting Punch - The starting punch has a tapered shank. It is used to start rivets, bolts, and pins out for removal.

Pin Punch - This punch is used to drive out rivets, bolts, and pins.

Center Punch - This punch is used mainly to mark parts when disassembling and scarring metal for drilling.

Aligning Punch - The aligning punch is used to drive in openings and to align parts and prevent them from shifting.

Taps and Dies - Taps are used to cut threads in holes, and dies are used to cut threads on bolts and rods. Taps are used to cut internal threads and dies to cut external threads. There are many kinds of taps and dies, but for general use the following types will do the job:

Taper Tap - This tap has five or six threads which make it easy to start. It cannot be used in blind holes where threads extend to the bottom.

Plug Tap - This tap has three or four threads, and it is a tapered tap. It can be used in a blind hole if the hole is drilled deeper than the bottom of the threads.

Bottoming Tap - The bottoming tap is used when the thread is to be cut to the bottom of the hole.

Pipe Tap - Threads usually taper 3/4 inch per foot of length on this tap. The tap size indicates the pipe size. It does not indicate the thread diameter.

Solid Dies - Solid dies are not adjustable; therefore, they are not as popular as adjustable dies.

Adjustable Split Dies - The standard thread split die is one of the most common used for threading bolts.

Two Part Adjustable Dies - These dies have a wide range of adjustments. They will cut most standard threads.

Twist Drills - The better quality twist drills are made of high speed steel and generally have HS written on the shank. Two-fluted drills are used to drill solid steel. Drill shanks are straight, taper or morse, square, and blacksmith's.

The drill point should be properly ground for a specific use. The lip is ground to a 59 degree angle to the drill axis. The location for drilling should be center punched and a lubricant used to keep the drill cool. The following three sets of drills are recommended for a mechanical shop:

Sizes 1/16 to 1/3 inch by 32nds
Numbers 1 to 60
Letters A to Z

Pullers - Pullers reduce and in most cases eliminate damage to fitted parts which are being removed or installed. The four most commonly used pullers and their uses are:

External Pullers - The jaws of the puller are hooked behind the gear, and the screw is placed on the shaft and turned with a wrench to force the gear off the shaft.

Press-Puller - The press-puller legs sit on the stationary part of the machine, and the shaft is pulled from the bore by turning the puller screw.

Internal Puller - This puller is used mainly to pull bearings from bores. The legs of the puller are placed on the stationary part of the machine, and the jaws of the puller grasp the bearing from the inside. As the puller screw is turned, the bearing is forced out.

Stud Puller - An unbroken stud (bolt) is pulled by dropping the stud puller over the stud and turning the tee. A broken stud (bolt) may be pulled by drilling a hole in the stud and forcing a chisel in the hole. The stud is removed by turning the chisel with a wrench.

Wrenches - There are many types of wrenches used in the repair of machinery. Some of these are:

Box End - This wrench is available with a 6 or 12 point opening and different lengths. It may have an offset to provide clearance for the hand.

Open End - An open end wrench is open at both ends. The opening is measured according to the size of the nut instead of the size of the bolt. The wrench may have the head set at an angle to give more turning area.

Combination Box and Open End - One end is closed and the other open on this wrench. Usually both ends are the same size.

Flare Nut - The flare nut wrench is very similar to the box end wrench, but it has a section cut out so that it will slip over tubing and tubing nuts. The wrench should be pulled so that the opening will not spread. It has a 6 or 12 point opening.

Socket - Socket wrenches are available in 6 or 12 point openings and 1/4, 3/8, 1/2, and 3/4 inch and larger drives. Drive size indicates the size of the hole in the base of the socket. They are available in two depths, standard and deep. Several different drive handles and attachments are used with socket wrenches. This list includes flex handles, sliding - T handles, spinner handles, ratchet handles, ratchet adapters. universal joints, socket reducing adapters, speed handles, and several sizes of extension bars.

Torque - A torque wrench measures resistance to turning. This resistance is called torque. Torque is based on the following law:

Force x Distance = Torque

If the lever length is in inches and the force is in pounds, the torque is measured in inch - pounds. If the lever length is in feet, the torque is measured in foot-pounds. Foot pounds multiplied by 12 equals inch-pounds. Inch pounds divided by 12 equals foot pounds.

The torque wrench can be pulled or pushed, but the reading should be taken while the wrench is in motion.

Pipe - The pipe wrench is used to grasp round or irregular objects. Inside and outside pipe wrenches are used. A pipe wrench will grasp the surface of an object by pulling toward the face side of the wrench. Some of the more common sizes are 12 to 24 inches in length.

Allen and Fluted - These wrenches are used to turn set and capscrews. Setscrew wrenches are usually hexagonal bars made in an L-shape. The wrench is inserted in the headless screw.

Spanner - Spanner wrenches are usually supplied with the machine. They are either hook or U-shaped in type.

Special Tools - The following special tools are used in the mechanics shop:

Probing Tools - Mechanical fingers, extension magnets, and mirror devices are helpful to recover dropped parts and see in blind areas.

Reamer - Reamers are used to enlarge or smooth holes. Some are adjustable, and some are fixed sizes. They are turned only in a clockwise direction and take only small cuts. Large cuts may damage the reamer.

Spring Tester - The spring tester is normally used to check valve and clutch springs. It is used by inserting the legs in the spring and pulling down on the handle. The pounds of pressure exerted and compressed length of spring should meet the specifications.

Micrometers, Gauges, Calipers, Dividers, and Other Measuring Tools - The types of micrometers are:

Outside - The outside micrometer is used to check the diameter of pistons, crankshafts, pins, and camshafts and the outside dimension of other parts in thousandths of an inch. The thimble is turned until an anvil face and spindle face touch the object.

Inside - This type of micrometer is used to determine the measurements in cylinder bores, brake drums, and certain bushings. There are two types -- for small and large measurements. The thimble is turned to spread the jaws apart until they touch both sides of the opening.

Depth - The depth of openings such as slots and holes are measured by the depth micrometer. The base is placed over the opening, and the pin is run down by turning the thimble until the pin reaches the bottom of the hole or opening. There are several different widths of depth gauges used on depth micrometers.

The Parts of a Micrometer - The principal parts of an outside micrometer are:

- Ratchet
- Thimble
- Barrel
- Spindle
- Frame
- Anvil
- Measuring faces

The thimble and barrel are marked with scales for making measurements.

How to Use a Micrometer - There are two major measurements used on micrometers. One type of micrometer is graduated in hundredths of a millimeter. This is a metric-measure micrometer. The other type is graduated in thousandths of an inch and is called an English measure micrometer. Steps in using a micrometer are:

Select the proper size of micrometer for making the measurement and adjust the opening a little larger than the thickness of the object to be measured.

Place the thimble between the thumb and forefingers and turn the thimble until the spindle and anvil points contact the object being measured.

Turn the racket two clicks, that is, if the micrometer is equipped with a ratchet. If a non-ratchet type is used, pressure is determined by "feel". Do not tighten the thimble so that the micrometer cannot be easily removed from the object.

If possible, take the reading while the micrometer is attached to the object. The reading may be taken after the micrometer is removed if care is taken not to move the spindle.

Readings may be made with calipers in places that are hard to measure with the micrometer, and the reading may be transferred to an inside micrometer.

Take the reading by using the following procedure:

Read the highest figure on the barrel.

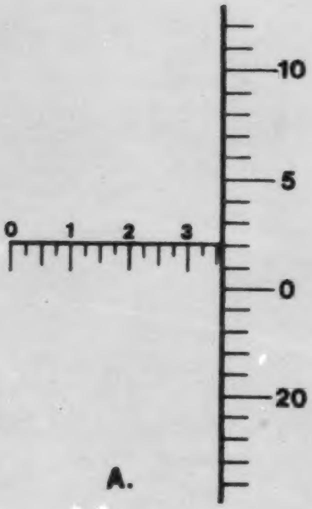
Read the number of lines that are visible on the barrel beyond the highest figure. Allow .025 for each line.

Mechanical Tools - Identification and Use
(Information sheet continued)

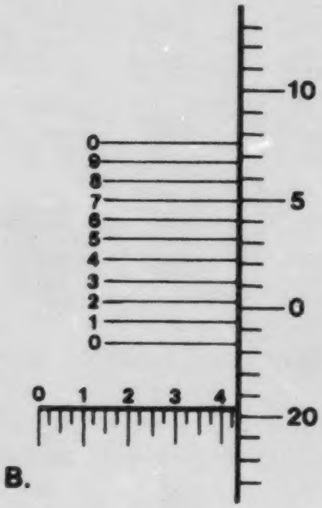
Read the thimble line that is in line with the datum line.

If the micrometer has a vernier scale, read only the vernier scale line that coincides exactly with the thimble line.

Micrometer readings without and with a vernier scale:



A.



B.

A.	Sleeve or barrel	3 =	.300	
	Sleeve or barrel	2 =	.050	
	Thimble	2 =	.002	
	Total		.352	

B.	Sleeve or barrel	4 =	.400	
	Sleeve	1 =	.025	
	Thimble	20 =	.020	
	Barrel-Vernier	=	.0006	(6/10,000)
	Total		.4456	

Types of other measuring tools include:

Dial Gauges - These gauges are used for measuring movements in thousandths of an inch. Various mounting arms, brackets, and adapters are used to mount the dial gauges so that they can be used for checking backlash between gears, valve lift, play in shafts, and cylinder taper.

Dial Cylinder Gauges - Cylinder gauges are used to check cylinder bore size, taper, and out of roundness.

Telescope Gauges - These gauges are used to measure grooves, slots, or inside cylinder walls. They are also used to measure inside the bore of bearing walls. An outside micrometer is used to measure across the plungers of the telescope gauge after a bore measurement is taken. These tools may be purchased in sets ranging from 1/2 to 2-1/2 inches.

Feeler Gauges - Feeler gauges are used to check clearances between two parts such as valve gaps and piston ring gaps. There are several blades in one set. The blades are marked in thousandths of an inch.

Wire Gauges - Wire gauges are used to check the points in a distributor and to set spark plug point gaps. They are made of steel wire.

Screw Pitch Gauges - These gauges are used to determine the number of threads per inch. They are also used to determine the depth of threads.

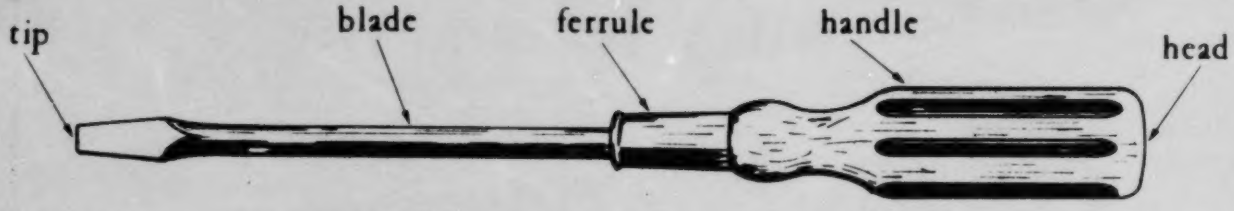
Dividers - Dividers are used for making circle and surface measurements. The top of dividers and adjustments resemble calipers.

Calipers - Calipers are used to measure outside and inside surfaces when accuracy is not considered critical. Measurements are taken on the caliper by a steel ruler.

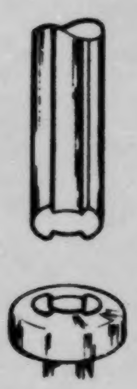
Spring Scales - Spring scales are used to determine the contact point pressure by ounces or pounds of pull on feeler strips when pistons are being fitted.

Steel Straight Edges - This type of straight edge is used to check the block for warpage. The straight edge should be long enough to span the block.

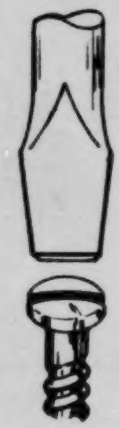
TYPES OF SCREWDRIVERS


tip
blade
ferrule
handle
head

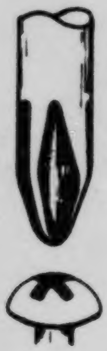
PARTS OF A SCREWDRIVER



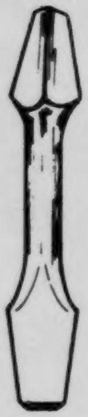
CLUTCH-HEAD



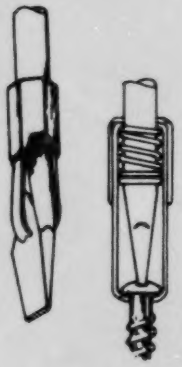
STANDARD



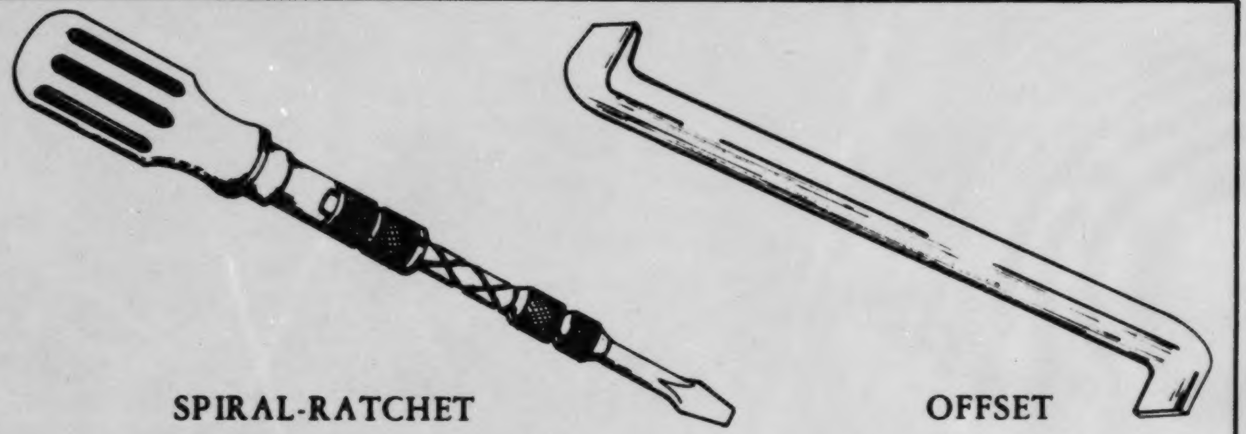
PHILLIPS



SCREWDRIVER BIT



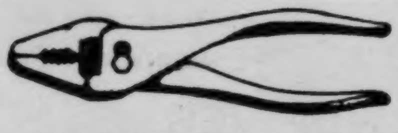
STARTING



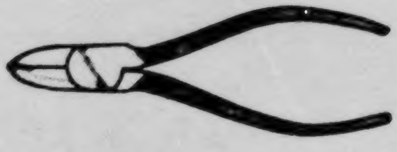
SPIRAL-RATCHET

OFFSET

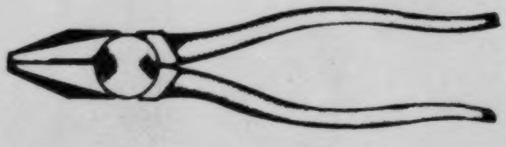
COMMON TYPES OF PLIERS & HAMMERS



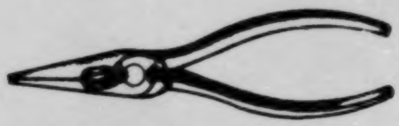
COMBINATION



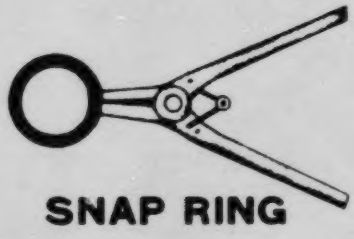
DIAGONAL CUTTER



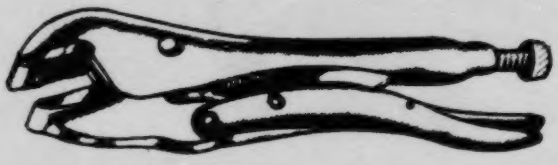
SIDE CUTTER



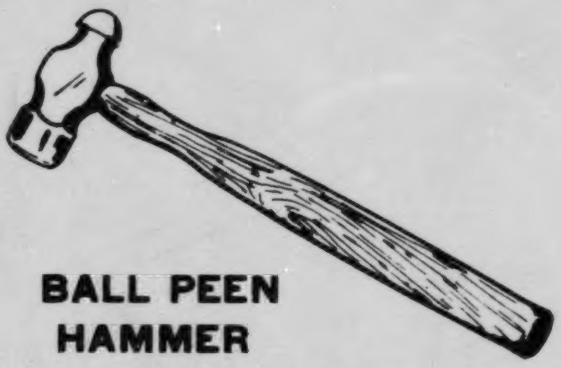
NEEDLE NOSE



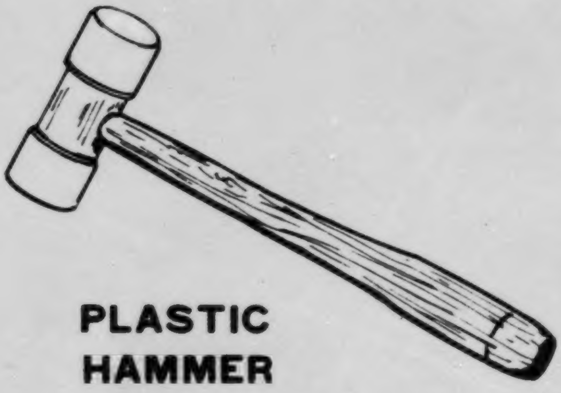
SNAP RING



LOCK GRIP

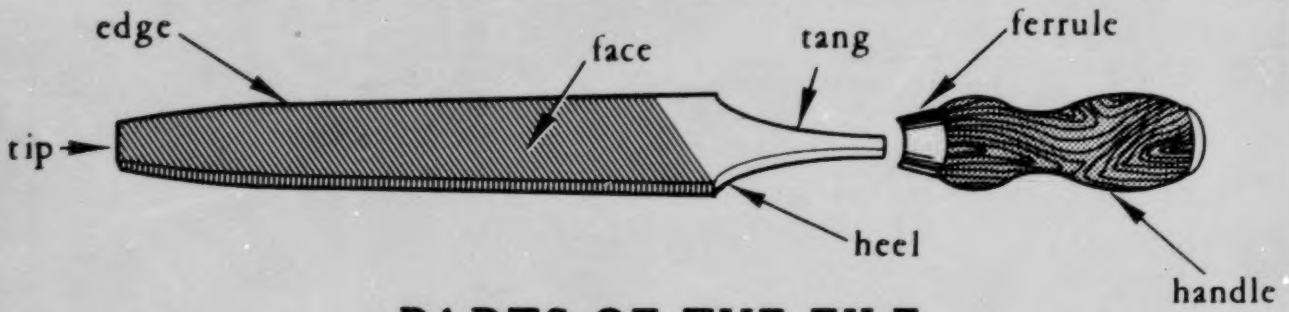


BALL PEEN HAMMER

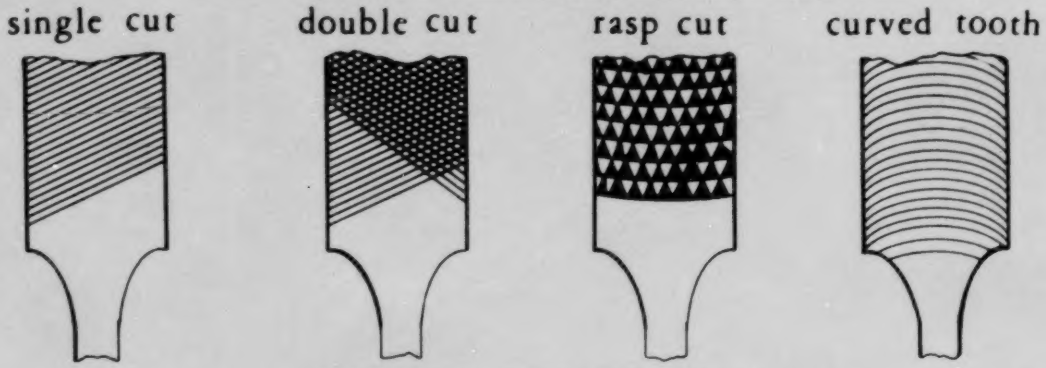


PLASTIC HAMMER

TYPES OF FILES

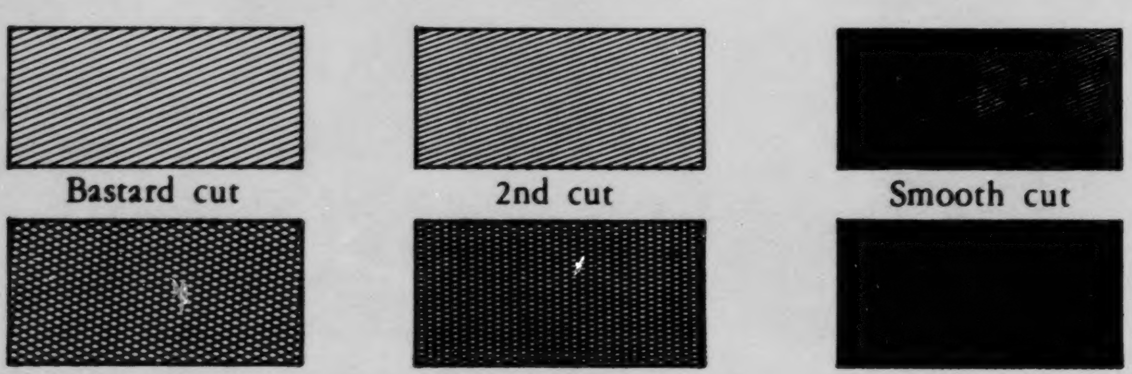

edge
face
tang
ferrule
tip
heel
handle

PARTS OF THE FILE


single cut
double cut
rasp cut
curved tooth

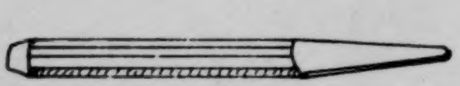
TYPES OF TEETH

SINGLE-CUT TEETH

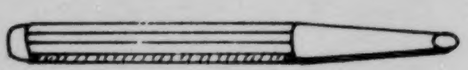

Bastard cut
2nd cut
Smooth cut

DOUBLE-CUT TEETH

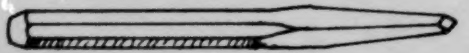
CHISELS AND PUNCHES



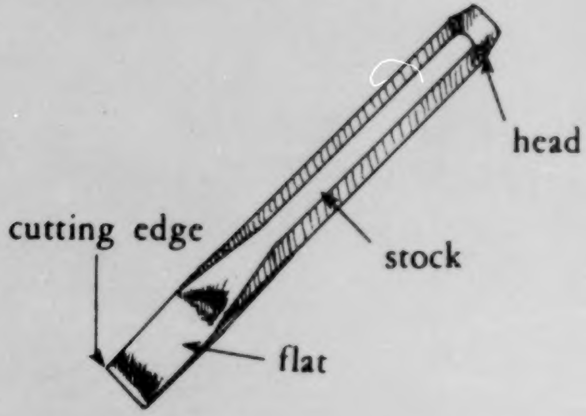
CAPE



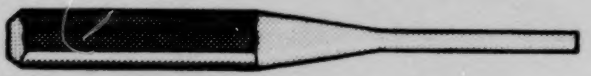
ROUND NOSE



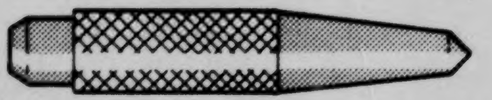
DIAMOND POINT


head
cutting edge
stock
flat

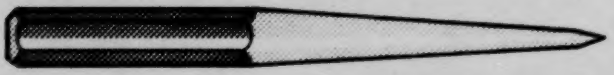
FLAT CHISEL



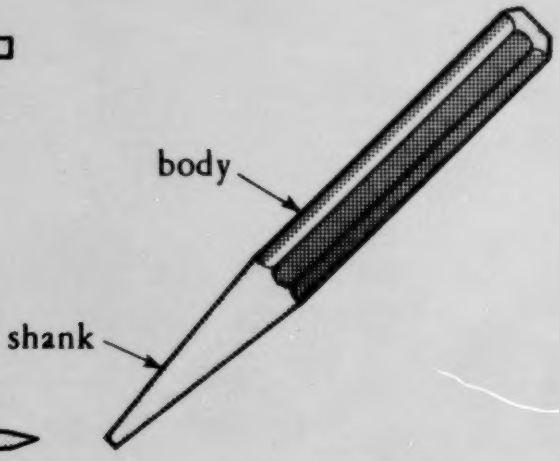
PIN PUNCH



CENTER PUNCH



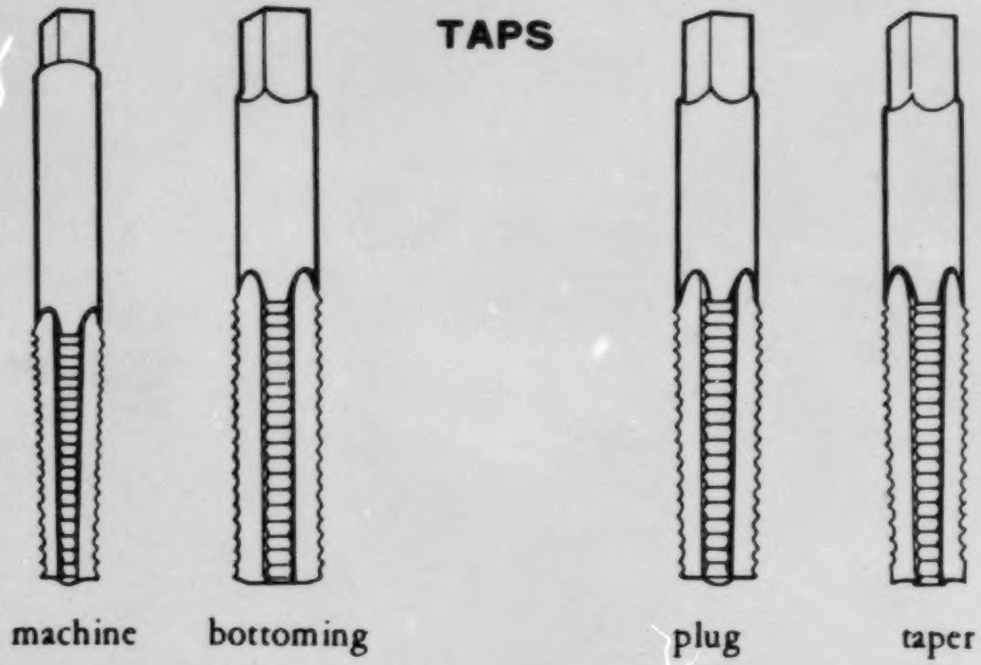
ALIGNING PUNCH



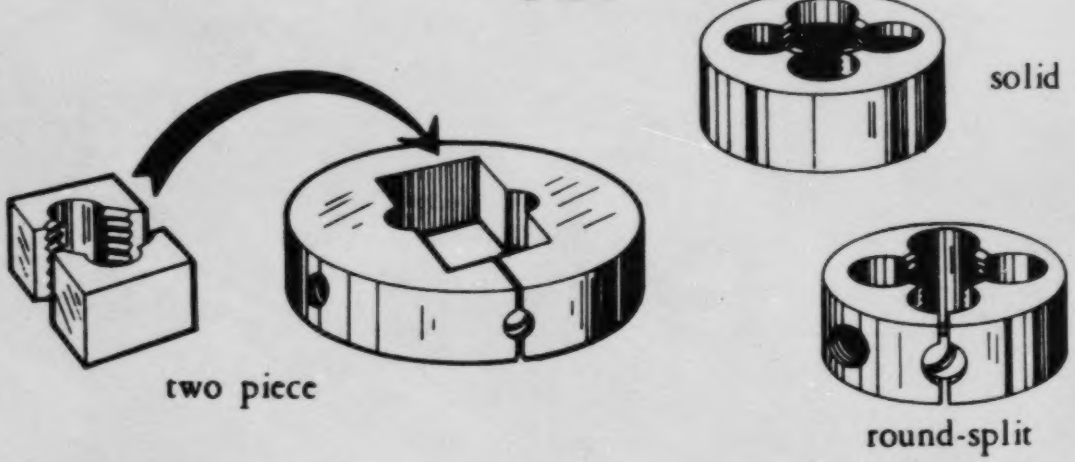
STARTING PUNCH

TAPPING & THREADING

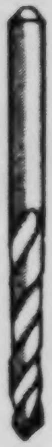
TAPS


machine
bottoming
plug
taper

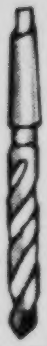
DIES


solid
two piece
round-split

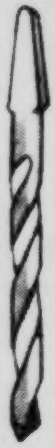
TWIST DRILL SHANKS & PARTS



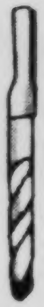
STRAIGHT SHANK



TALLER OR MORSE SHANK

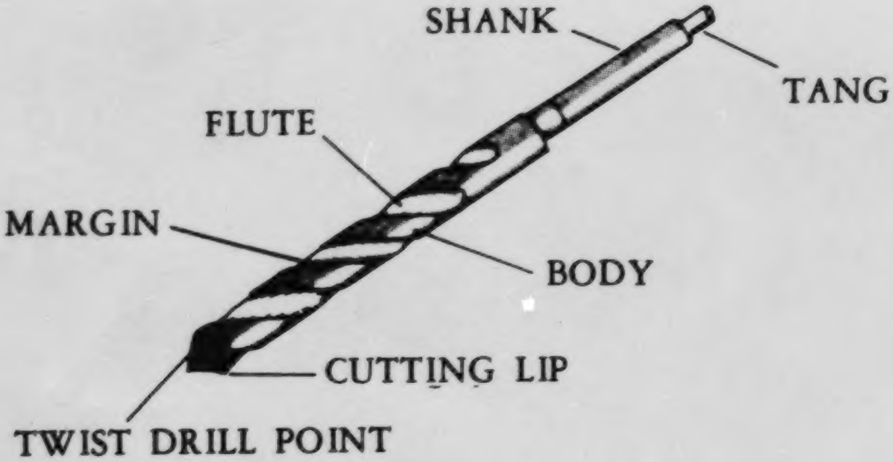


SQUARE SHANK

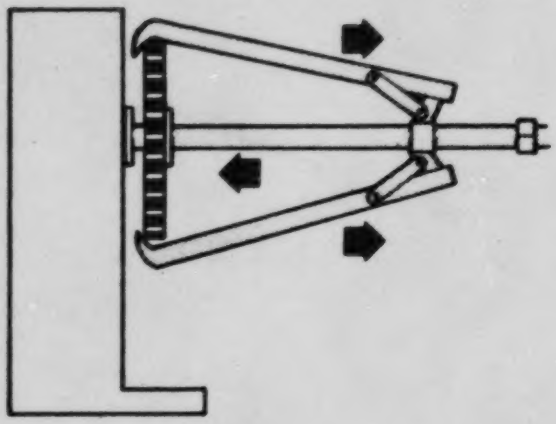


BLACKSMITH'S SHANK

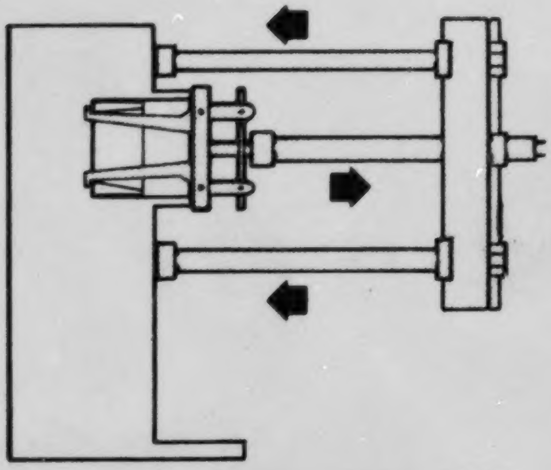
TWIST DRILL PARTS


SHANK
TANG
FLUTE
MARGIN
BODY
CUTTING LIP
TWIST DRILL POINT

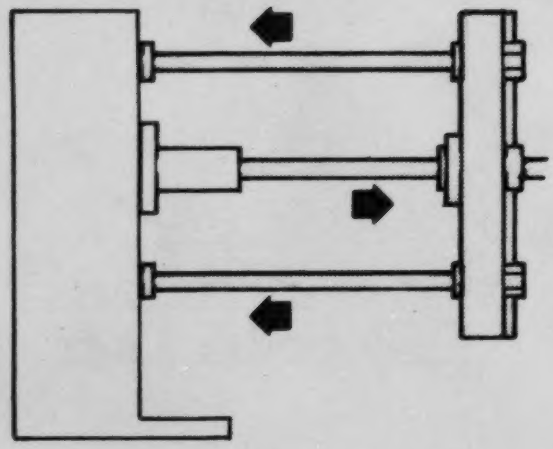
PULLING GEARS, BEARINGS, & SHAFTS & REMOVING BROKEN BOLTS



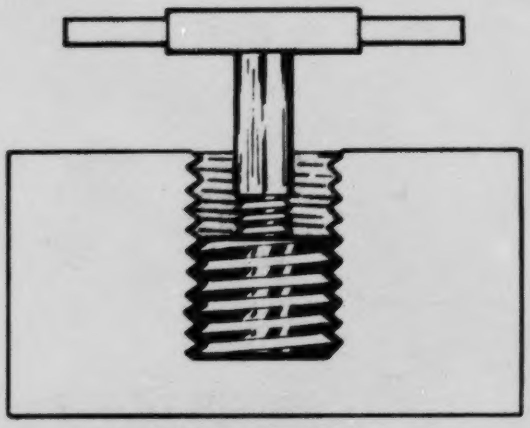
GEAR PULLED FROM SHAFT



BEARING REMOVED FROM BORE

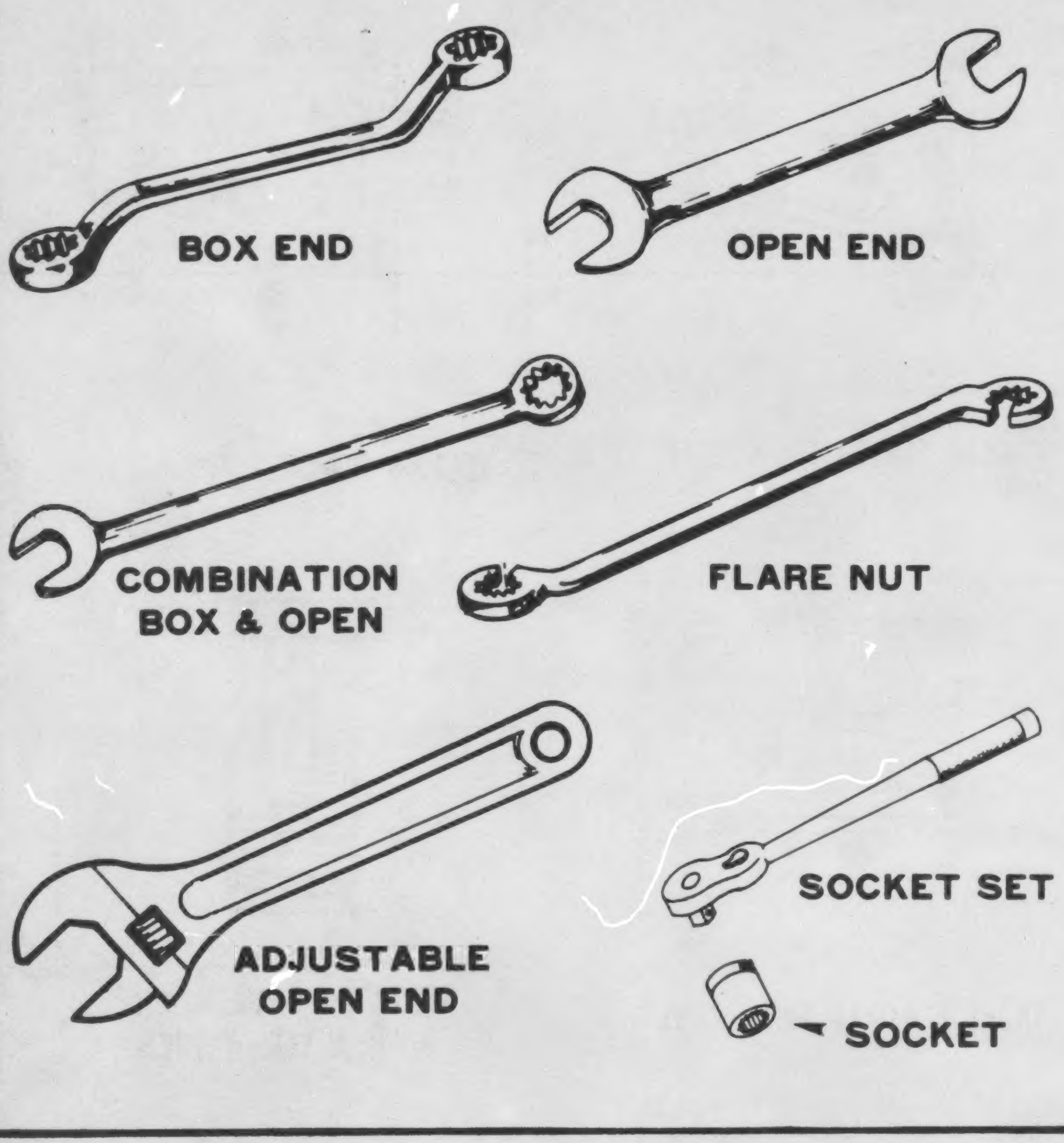


SHAFT REMOVED FROM BORE

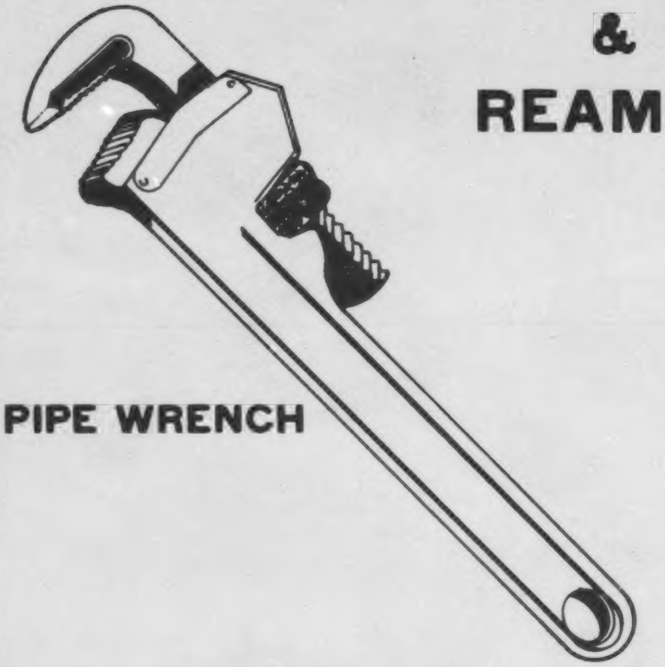


REMOVING BROKEN BOLT
WITH A TAP WRENCH

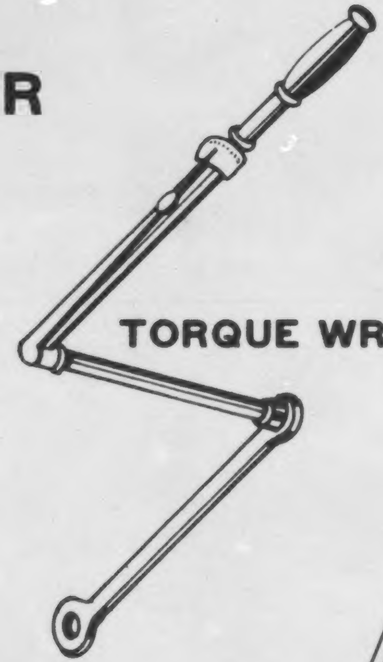
TYPES OF WRENCHES


BOX END
OPEN END
COMBINATION
BOX & OPEN
FLARE NUT
ADJUSTABLE
OPEN END
SOCKET SET
SOCKET

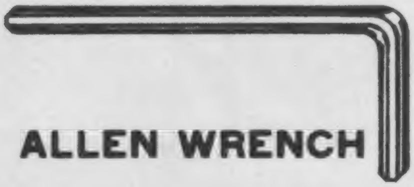
WRENCHES, PROBING TOOLS, & REAMER



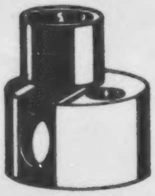
PIPE WRENCH



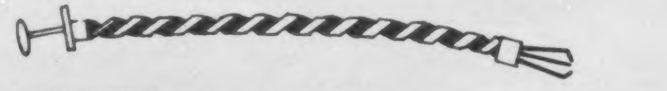
TORQUE WRENCH



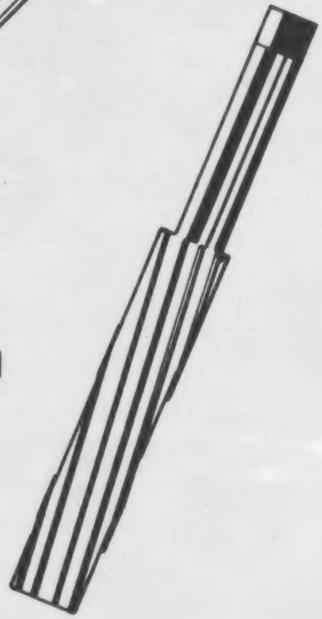
ALLEN WRENCH



STUD WRENCH

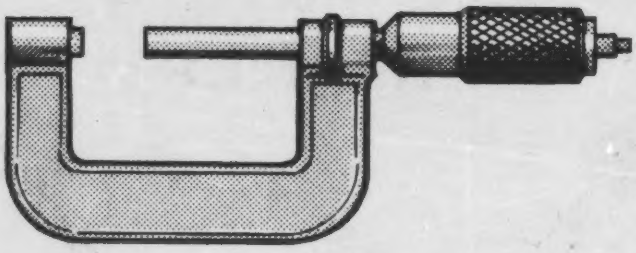


MECHANICAL FINGERS

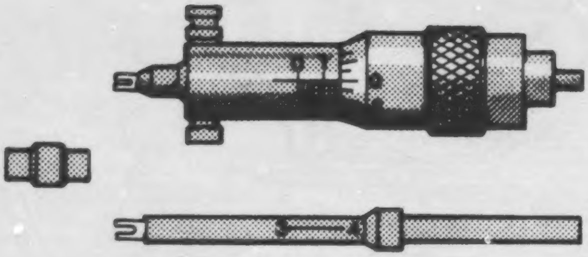


SPIRAL FLUTE REAMER

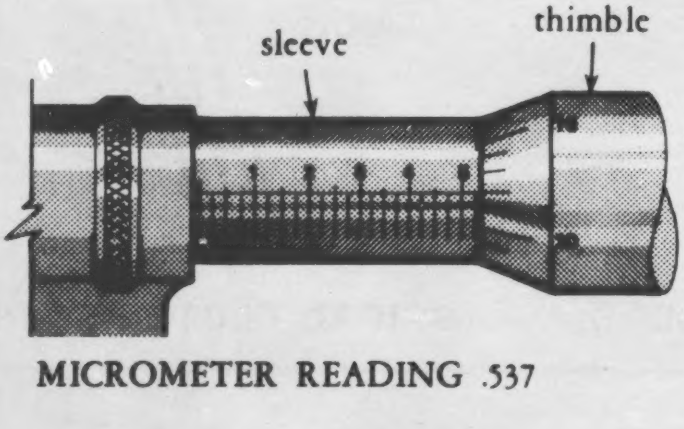
PRECISION MEASURING TOOLS



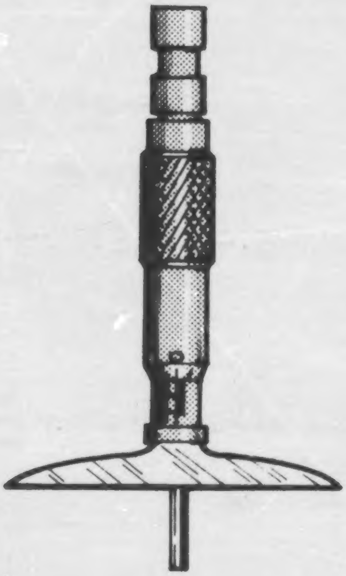
OUTSIDE MICROMETER



INSIDE MICROMETER

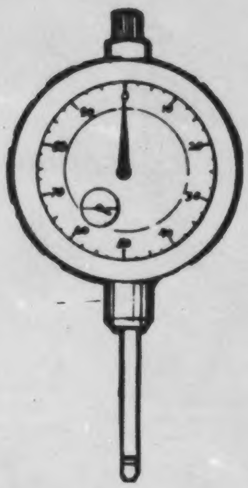


MICROMETER READING .537

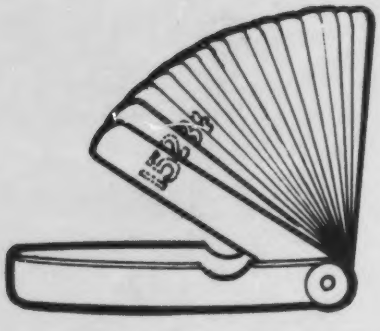


DEPTH MICROMETER

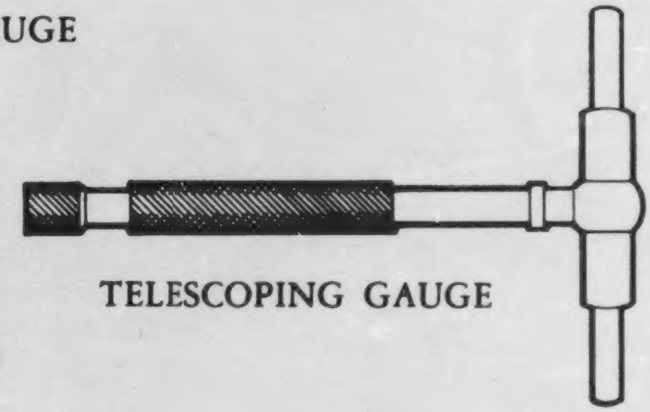
PRECISION MEASURING TOOLS



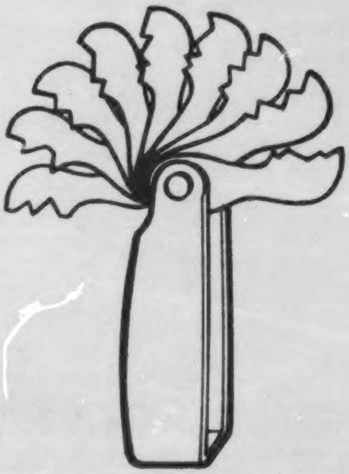
DIAL(THICKNESS)GAUGE



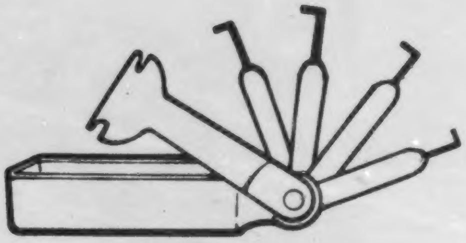
FEELER GAUGE



TELESCOPING GAUGE

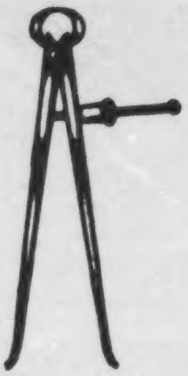


SCREW PATCH GAUGE

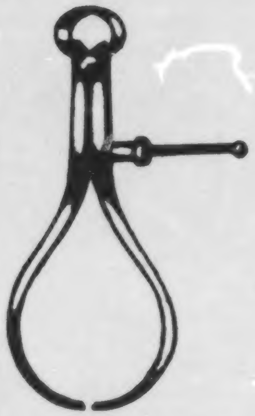


WIRE GAUGE

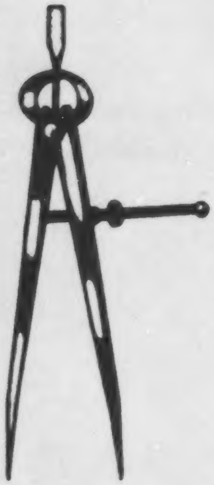
OTHER MEASURING TOOLS



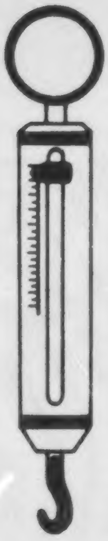
INSIDE CALIPER



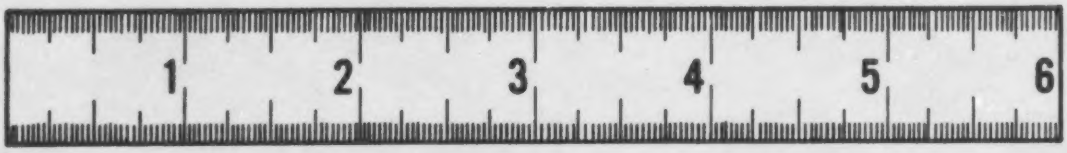
OUTSIDE CALIPER



DIVIDERS



SPRING SCALES



STEEL RULE

Assignment Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Introduction

TOPIC: Use of Holding Devices, Jacks, Lifts, and Hydraulic Presses

OBJECTIVE: To develop an understanding of the importance of using holding devices and lifts in a machinery and equipment repair shop.

REFERENCE:
Information Sheet, "Use of Holding Devices, Jacks, Lifts, and Hydraulic Presses"

QUESTIONS AND ACTIVITIES:

1. What are the three common types of hand operated jacks?
2. List the uses of a hand operated hydraulic jack.
3. What are the main uses of floor jacks?
4. What are the major parts of hydraulic jacks?
5. List other types of jacks that are used in a repair shop to handle equipment during repair jobs.

Information Sheet
on
USE OF HOLDING DEVICES, JACKS, LIFTS, AND HYDRAULIC PRESSES

Most repair shops have more than one type of equipment for lifting, pressing, and bending. Some shops may be equipped with hydraulic hand jacks, hydraulic floor jacks, adjustable jack stands, special parts jacks, crane assembly or "A" frame with hand or power operated hoist, and special suspension lift.

One of the most commonly used hand jacks is the hydraulic type that supports a load capacity between 1-1/2 and 5 tons. The rachet teeth and screw type hand jacks have been largely replaced with the hydraulic hand jack. This type of jack can produce great pressure with its short compact frame. It is used for lifting, pushing parts in line, and bending metal parts of machinery. The hydraulic hand jack is usually correctly aligned and secured in place when it is put under pressure.

The hydraulic floor jack is one of the most versatile jacks used in equipment repair. These jacks are made in various sizes -- one to twenty tons. The jack is operated by working a long handle up and down. Some of these jacks are equipped with a rapid rise foot pump. Heavy duty floor jacks are used to raise front, rear, or side of a machine or piece of equipment. They can be used to maneuver a powered machine or its parts in close or tight quarters. The major parts of a floor jack are as follows:

Body
Control valve
Saddle
Handle
Rapid rise foot pump
Rollers

Jack stands are used to lift and hold loads. Usually the raising or lowering of the saddle on a jack stand is to balance the load after the load has been lifted to a desired height by a jack or other lifting device. Both ratchet and screw type stands are commonly used. Jack stands should be placed on the part of the machine or frame that will support it. The saddle should not be placed against bolts, other fasteners, or on tapered edges of the machine.

Some types of lifts are air-operated. These lifts are either the mobile type that may be moved from place to place in the shop or the large post stationary lifts that can lift all or parts or certain machines.

Almost all farm implement shops have some type of hoist. They may be lever operated, differential chain (hand) operated, electric operated, or a combination of hand and electrical operated type. The light service hoist will lift from 500 to 3000 pounds, whereas heavy duty hoists will lift to 10 tons. The light service hoist may be mounted to an "A" frame by a hook that is usually mounted stationary on the frame. Hoist trolleys

Use of Holding Devices, Jacks, Lifts, and Hydraulic Presses
(Information Sheet continued)

are usually mounted on well supported stationary I-beams. Heavy duty hoists are mounted to heavy I-beam assemblies or bridge crane assemblies. Many mechanical shops will have medium duty (2 to 3 ton) hoists mounted on I-beams. These hoists are used mainly for lifting power units, wheels, and heavy parts of equipment. Hoists should be operated by experienced mechanics.

The hydraulic press is a very useful piece of equipment in the repair shop. It is used to remove bearings from such places as axles and hubs, to press bearings in place, remove and insert pins, and to straighten shafts on equipment and machines. A 25 ton capacity press is adequate for hoist jobs in the repair shop. Some shops are equipped with portable hydraulic power units. The unit usually consists of a hydraulic pump, base or foot saddle, power unit or head, ram extension, and saddle. This unit resembles a rod or post when assembled that extends when hydraulic pressure is applied. It may be used to lift heavy parts into place or to straighten certain damaged parts on the machine.

Repair stands are considered a very important piece of shop equipment where it is necessary to work on gear units, blocks, and other major parts of power equipment. Most stands are equipped with adjustments that will allow the machine part to be positioned for work.

Assignment Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Introduction

TOPIC: Use of Equipment Manuals

OBJECTIVE: To develop an understanding of the importance of service and operator's manuals for shop and field use.

REFERENCES:
Information Sheet, "Use of Equipment Manuals"

QUESTIONS AND ACTIVITIES:

1. List the three types of manuals used in agricultural machinery service and repair operations.
2. Why is it important that the instructions in an operator's manual be followed?
3. What is the main purpose of the service manual?
4. How is the special shop service manual similar to a general service manual?
5. What is the main difference in a shop service manual and an operator's manual?
6. Who should use the shop manual?
7. What is the fourth type of manual that can be used by the repairman?
8. Who should use the operator's manual?

Information Sheet
on
USE OF EQUIPMENT MANUALS

An equipment manufacturer furnishes an operator's manual for most all types of farm machinery and special equipment. When a farmer purchases a piece of equipment one of these manuals is presented to him by the dealer or sent directly from the factory. If the buyer fails to receive an operator's manual, he should contact the dealer and request one. Following the instructions given in the manual will lengthen the life of the equipment and cause it to function more properly.

There are three important types of manuals used in agricultural machinery service and repair operations. They are the operator's manual, service manual, and special shop service manual. Many service and special service manuals are published by technical publishing companies which are disassociated with the manufacturer of the equipment.

The operator's manual includes the following information for a single machine or piece of equipment:

Specifications of the machine or pieces of equipment (name, size, and capacity of parts)

Operation of the machine or equipment (function of parts and starting, handling, and stopping the machine)

Fuels and lubricants used by the machine (type and amount of fuel and lubricants to use) or power equipment

Servicing the machine or piece of equipment (fuel, cooling, ignition, and lubricants to use)

Trouble-shooting (locating and diagnosing operation problems)

Safety (practices that eliminate accidents)

The performance and length of useful life of a machine and certain types of equipment may depend on how closely the operator follows the instructions in the operator's manual. For example, the manual may suggest how often the valves should be adjusted on power equipment in order that it function properly at all times, or that the chains and belts be adjusted on a combine to make it function properly and eliminate bearing wear.

It is absolutely necessary that the operator follow the instructions of the operator's manual when operating and servicing the machine. Many operator's manuals may be used as references for repair work.

Use of Equipment Manuals
(Information Sheet continued)

The service manual is used as a guide when servicing the entire machine. It is used by the service center as a guide for making adjustments and repairs. In general the manual furnishes the following information:

> Complete instructions for inspection, disassembly, repair, assembly, and the installation of the parts of a machine
>
> A description of parts (dimensions and name), tests, and adjustments of certain parts and systems
>
> Correct name of equipment and model

The service manual is considered a good text book for training service center personnel. The use of this manual may reduce time, error, and cost in making machinery repairs.

Special shop service manuals are similar to the regular service manual, in that they give information on disassembly, repair, and assembly of machine parts. The specifications include the name, dimension, fits, clearances, and complete instructions on installation of machine parts. Each part is identified similar to the identification system found in a parts catalog for a particular machine. A mechanic may use this type of information when repairing a machine.

The manual gives information on trouble shooting, testing, and lubrication. One of the most valuable features of this manual is the pictures and sketches of parts and systems of a machine. The sketches show the sequence of assembling the parts and systems.

Unlike the operator's manual, the shop service manual may contain a series of certain types of machines. The operator's manual pertains to a single machine.

The shop manual is considered very important for the skilled mechanic. This manual may be considered as an inspection, repair, and adjustment source of information to use in the service center.

There are operation and maintenance manuals for powered equipment that give information on operation and maintenance practices, but do not refer to any one specific make of machine. The information in this type of material is presented so that it can apply in general to various brand names of machines. This type of manual may deal with belts, chains, bearings, lubricants, gears, paints, and seals. It also may explain the servicing of parts, care of the equipment while in storage, trouble shooting and an hourly or daily check schedule. Some general operation manuals present information on starting, operating, stopping, hitching, unhitching, and adjustments and controlling the movement of the equipment. For example, a general maintenance manual for planters may give information on the care of major parts, adjustment of the entire planting mechanism, safety practices, lubrication, and other practices to reduce excessive wear. This type of service manual is not used for repair work other than identifying the parts in a general way.

Assignment Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Introduction

TOPIC: Equipment Inspection

OBJECTIVE: To understand the importance of inspecting machinery and equipment for major and minor repair jobs.

REFERENCES:
Information Sheet, "Equipment Inspection"

QUESTIONS AND ACTIVITIES:

1. Why is it important to inspect farm equipment at the end of the work season?
2. What type of information is generally found in the inspection form?
3. List some common types of machines or equipment that may require inspection.
4. Explain how to properly inspect a moldboard plow.
5. Why is time a factor when checking a combine?
6. Why is it necessary that the piece of equipment have a good coat of paint?
7. List at least five reasons why the equipment owner fails to properly inspect the machine.

Information Sheet
on
EQUIPMENT INSPECTION

One of the best ways to eliminate costly repair jobs is to thoroughly inspect equipment periodically during the season or period that it is in use. A machine operator or owner should use a systematic procedure for checking the parts of equipment or machines. Farm machinery may be inspected anytime throughout the year, but the more desirable period for inspection is at the close of the working season. The major reasons for inspecting the machine at the end of the work period are:

Adequate time is needed to make a thorough inspection.

It may be necessary to replace worn or damaged parts. Also, it may be necessary that the dealer order parts from the manufacturer.

The machine should be thoroughly cleaned. This operation should not be a hurried up type of job.

Major repairs may require several weeks to complete; therefore, the machine should be inspected immediately at the end of the working season.

Some owners and some operators of farm machinery use a special inspection form in order to list all information necessary for making machine repairs. This form contains the following information:

- Name of machine
- Make of machine
- Model and type of machine
- Date of inspection
- Condition of parts of assembly
- Name of part of assembly
- Type of work or job
- Part or parts needed
- Catalog number

If the following machines or pieces of equipment are delivered to a repair shop for a general over-haul or general repair work, some of the more important things to check are:

Disk Plows, Tillers, and Disk Harrows - When making the inspection, check the disk cutting edge for sharpness, bearings for wear, disk cleanness, looseness, springs for tension, scrapers for adjustment, and frame parts for distortion.

Planters - Inspect the parts of the hopper. All gears, chains, and sprockets should be checked. Inspect cut-off and knockout pawls, bottom rings. and spring tension. Inspect the valve mechanism and furrow openers.

Equipment Inspection
(Information Sheet continued)

Moldboard Plows - Inspect the plow share for sharpness and the plow bottom and side for suction. Check furrow wheel bearing, plow beams, braces, hitches, pivots, and linkage for wear and/or distortion.

Cultivators - Inspect all parts of the tractor-mounted cultivator for wear. Check shank releases (spring, friction, and pin-break) for adjustment. Inspect sweep or shovel cutting edges for sharpness, and check spacing of sweeps or shovels.

Tractor-Mounted Mowers - Check the mower knives for a proper cutting edge. Check for proper knife register in the guards. Inspect the wrist pin, bearings, and flywheel for wear. If the mower is equipped with a pitman check the wear; check pitman lead and lag. Check the bolt for wear on a pitmanless drive mower. There are many other check points on a mower. Some are: the guard alignment, knife straightness, knife head bushing, knife rivets, guard ledger plates, guard lip clearance, adjustable wear plate, drive pulley on pitmanless mower, and vertical and side play at knife head. Examine the cutter bar assembly for wear.

Rotary Mowers - Check the knives for proper cutting edges, excessive wear, nicks, and straightness. Examine all nuts and bolts for tightness. Check the drive shaft and bearings for wear and adjustment. Check for proper clutch action.

Balers - Balers have many moving parts, and each part serves a very important function for proper machine operation. It is important that the machine be carefully checked throughout the baling season. A frequent inspection should include the following:

Check all belts and chains for correct tension, wear, and alignment.
Check pulleys and sheaves for alignment.
Check bearings and sprocket teeth for wear.
Check the entire feeder unit for wear and damaged parts.
Check plunger speed and the plunger drive bolts for tension.
Check clearance between plunger and slide blocks.
Check the cutting edge and clearance of the slicing knives.
Check the weight and density of the bales.
Check the entire tying mechanism.

Combines - Combines are similar to hay balers, in that they are made up of many moving parts. Some parts may work independently of each other, yet if the machine is to operate properly, all parts in each mechanism unit must be in good condition at all times. An inspection of the combine will include the following jobs:

Equipment Inspection
(Information Sheet continued)

Check for worn and loose chains, sprockets, belts, and bearings.
Check the canvas for tears and check for loose or broken slats.
Check for auger straightness and wear.
Check the cylinder rub-bars for wear and other damage.
Check a spike-tooth cylinder for bent, broken, and worn teeth. Also check the cylinder RPM.
Check for loose rivets and bolts on the straw rack.
Check for holes in the grain pan, dents in the sieves, and bent air fan valves.
Check the elevator and augers for damages.

Sprayers - Sprayers usually receive better care than other machinery due to their being cleaned after each job. Fertilizer distributors are also cleaned after a job. Sprayers can be easily damaged by chemicals if they are not properly cleaned and inspected immediately after use. The following parts of a sprayer should be checked: nozzles, pressure gauge, belts, pulleys, bearings, hose and pipe connections, agitator, tank, hand gun, valves, strainers, and pump. Check parts that require lubrication.

If the machine is equipped with tires, they should be checked for wear and general condition. Machine parts that require oil or grease should be checked for proper lubrication. Machines are painted in order to protect the material against heat, moisture, and chemical reaction and to improve appearance. When inspecting the machine at the end of the working season the paint should be inspected to determine if it is cracking, checking, pealing, and/or chalking.

There are several reasons why equipment owners do not inspect their machines and equipment for repair. Some of the more common reasons are:

Lack of knowledge about the proper functioning of machine and equipment parts

Lack of time necessary to complete an equipment inspection

Lack of another piece of equipment to replace the equipment being inspected

Lack of proper tools to complete a thorough inspection.

Machines under warranty will usually be inspected by the dealer.

Dealer will have a shop mechanic inspect equipment even though it has been inspected by the owner.

A type of inspection form that may be used by the owner is shown on the following page.

MACHINERY INSPECTION FORM

Machine ____________ **Model** ____________

Make ____________ **Date** ____________

Name of Part	Condition of Part	Type of Job	Needed Part	Part Number

Detail Information

Assignment Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Introduction

TOPIC: Fasteners Used on Equipment

OBJECTIVE: To determine the types of fasteners that are used on equipment.

REFERENCE:
Information Sheet, "Fasteners Used on Equipment

QUESTIONS OR ACTIVITIES:
1. List five types of fasteners that are found on equipment.
2. When are the common types of bolts generally used for industrial purposes?
3. When ordering a bolt, what type of information should be given on the purchase order?
4. Give the two principal bolt thread series that are used in equipment construction.
5. List several types of nut designs.
6. List the most common types of lock washers used on machines and equipment.
7. What types of heads are found on machine screws?
8. What is the difference between using rivets and bolts in fastening metal together?
9. Describe the use of the following fasteners: studs, cotter pins, lock washers, and setscrews.

Information Sheet
on
FASTENERS USED ON EQUIPMENT

Modern equipment and machines usually operate under heavy loads and in most cases under severe stress. Fasteners (bolts and nuts, screws, rivets, pins, keys, and lock washers) are very important to the proper function of the machine.

The purpose of fasteners is to hold the parts of the machine together under operating conditions. Each fastener is made for a specific purpose, and it should be used according to the machine specifications. Bolts and screws are usually found in larger numbers than other fasteners on a machine. There is a difference between bolts and screws as fasteners for equipment.

A bolt is usually thought of as a device used with a nut to fasten two parts together. A screw is usually thought of as a device for fastening two pieces together by passing through a hole in one and screwing into a tapped hole in the other, without the use of a nut. Bolts are usually sold with the nuts accompanying them, while screws are not provided with nuts.

The head (and nut) of a bolt is generally square or hexagon and is tightened by means of a wrench. The head of a screw is usually round in shape and is provided with a slot or some other means of tightening with a blade such as a screwdriver. (Exception: hex-head cap screw.)

The sizes of bolts are usually given in fractional inch sizes, such as 1/4", 5/6", etc., while the sizes of screws may be in fractional inch sizes but are usually expressed in numbers from 0 to 30, to denote the gauge size of the steel wire from which the screws are made.

The term "screw thread" refers to both bolts and screws. A screw thread is measured by the number of threads per inch. The pitch of a thread (the distance between the crest and adjoining threads) is measured with a screw pitch gauge. The pitch becomes larger as the diameter increases.

The American Standard Thread Form is divided into two principal series: National Coarse and National Fine. The form of the thread is the same regardless of whether it is coarse or fine, the difference being in the number of threads in one inch for the same diameter screw or bolt. The designation of these two series is (1) National Coarse (formerly known as United States Standard or USS) and (2) National Fine (formerly known as Society of Automotive Engineers or SAE).

Thus a certain bolt, say a hexagon head, 1/4" in diameter, 2-1/2" in length, may have American Standard threads of either the coarse series (NC:USS) or the fine series (NF:SAE) and its description in a catalog will be:

Fasteners Used on Equipment
(Information Sheet continued)

1/4 - 20 x 2-1/2 (NC or USS) Hex Head Bolt
1/4 - 28 x 2-1/2 (NF or SAE) Hex Head Bolt

The 20 and 28 have reference to the number of threads per inch for a bolt of 1/4" diameter in the coarse and fine series respectively.

For a bolt of larger diameter, say 1/2", it is necessary that the threads be larger and fewer per inch for both the coarse and the fine series. In this case the thread description of the bolt will be:

1/2 - 13 x 2-1/2 (NC or USS)
1/2 - 20 X 2-1/2 (NF or Sae)

Definite standards have been set up governing the number of threads per inch for each size screw. The coarse series threads are used with machine bolts and screws for general industrial use, which, it is said, comprise about 80% of all manufactured.

The fine series threads (or about 20% of machine screws) were adopted when it was found that the coarser threads would not stand up under the pressure and vibration found in modern machinery, principally automobiles. The term SAE refers to "Society of Automotive Engineers", which was instrumental in the standardization of machine screw threads.

For use in automobiles, the Society of Automotive Engineers adopted still another series, the Extra Fine thread series, for use in certain instances with thin metal where the thread engagement is small. In this series, a 1/2" screw will have 28 threads per inch. instead of 20 in the National Fine series. Thread series may be identified as follows:

UNC - Unified National Coarse
UNF - Unified National Fine
UNEF - Unified National Extra Fine

One of the most common types of fastening devices found in industry is the bolt, which is a steel rod, threaded on one end and a head on the other. The head is usually six-sided (hexagon or hex), and each side is called a "face". The distance between any two opposite faces (flats) of the head determines the wrench size.

Bolt Sizes - The dimensions of a bolt are determined by using its diameter (D), and length as units of measure.

Fasteners Used on Equipment
(Information Sheet continued)

The diameter of a bolt is the diameter of the body (not the head), the smallest being usually 1/4". The diameters range from 1/4" to 3".

The length of a bolt is measured from the underside of the head to the end and varies according to the use to which the bolt is put.

The head size of a bolt (W) is the wrench size and is the distance across flats. For standard hexagon machine bolts, it is equal to 1-1/2 times the diameter of the bolt. However, the bolts used by automobile manufacturers do not follow this formula exactly. An explanation of SAE bolt and nuts sizes is given in the information sheet, "Wrenches".

When referring to bolts as in orders, parts lists, and correspondence, a standard manner of designating the necessary information is used, with the data listed in the following order:

1. Diameter
2. Length
3. Type thread
4. Finish
5. Type head
6. Name

This information is usually abbreviated as shown in the following example:

1/2" x 2-1/4" - 20 NF - 2 Fin. - HEX. MACHINE BOLT

The most common types of bolts used for general industrial purposes are: (1) machine bolt, (2) stove bolt, (3) carriage bolt, (4) stud bolt (or stud), and (5) hanger bolt.

Nuts are designed in several types to suit different needs. The most common types are: square, hexagon, slotted head hexagon, castle or castellated, cap (also called acron and blind), speed, and wing. The hexagon is by far the most used nut in automotive work, and it comes in three different thicknesses: heavy (standard), light (half nut), and jam (lock). The jam is the thinnest and is used with another nut, usually a light or half nut, to lock it on the bolt. The speed nut has two prongs to engage the thread on the bolt.

Small thin nuts are sometimes incorrectly called "taps" in certain parts of the country. (A tap is a fluted, threaded tool for cutting inside threads.)

Nuts are of the same size, thread form, and pitch as the bolt they fit. The standard hexagon nut is also the same diameter as the bolt head but is somewhat thicker. The thread of a nut is internal (female), and the same standard thread systems apply to them as apply to bolts.

Fasteners Used on Equipment
(Information Sheet continued)

Practically all nuts should be used with a washer of some type. However, some nuts have special safety devices which make this unnecessary. Slotted and castellated nuts are used with cotter pins or safety wire to prevent them from loosening on the bolt.

The different types of washers are important parts of bolts and screw fasteners for equipment and machinery repair work. One piece of equipment may contain several type of washers, including more than one type of lock-washer.

The most common types of lock washers used on machines are: external tip edge, split plain ring, and internal tipped edge.

Lock washers are used to hold the nut in place. The lock washer grips the surface of the nut and holds the nut in place.

Self-locking nuts are designed to produce a self-locking effect. Friction is either forced against the threads by a collar, nut end that is slotted and pinched, or a nut that has been distorted by a cut into the threads. The palnut is also considered a locking device. It is tightened one-half turn against the nut. The steel fingers of the palnut fit into the bolt threads forcing the palnut against the bolt nut.

There are several types of machine screws used on farm equipment. They all serve a similar purpose, to hold two or more pieces of metal together. A hole is drilled to pass the screw through the first part, but the hole in the next part is threaded for the screw. Therefore, no nut is needed when using this type of screw.

The heads of machine screws are made for different types of turning tools. The types of heads are:

> Slotted head, for use with the conventional type screwdriver. There is also a hexagon head, making it suitable for both an ordinary screwdriver or a "Spin-tite" wrench.
>
> Hexagon socket head, also known as "Allen head", used with the"L" shaped, hexagonal Allen wrench or key.
>
> Phillips head, which has a cross-shaped recess and is used with a Phillips screwdriver. Its chief values are ease of starting, attractive appearance, and the fact that the screwdriver cannot slip off the screw head while turning.
>
> Reed-Prince head, also known as "cross head", is somewhat similar to the Phillips head and used with a specially formed screwdriver bit.

Fasteners Used on Equipment
(Information Sheet continued)

Spline socket head, also called "fluted head", which uses a special splined wrench which permits a maximum amount of force to be applied without splitting or straining the screw head.

Clutch head, used with a special screwdriver bit designed to permit considerable turning force. It is claimed that this type screw head makes starting screws in hard-to-get places easier since the screw will fit the bit snugly without falling off.

Sheet metal screws are made to draw two pieces of thin metal together or to attach items or material to sheet metal. The heads may be slotted, phillips, or hex. The heads are also flat, round, or oval.

The screws are installed by drilling or punching a hole just smaller than the screw minus the threads. As the screw is forced into the hole, it cuts the threads. This type of screw is called a "self-tapping" screw.

Screws are designated in the same manner as bolts as shown in the example below:

(Complete)	No. 10 x 1-1/2" - 24 - 2 FIN FILL HD MACHINE SCREW
(Abbreviated)	10 x 1-1/2" - 24 FILL HD MACH SCR
(Complete)	No. 3/8 x 2-1/2" - 24 NF - 3 FIN HX HD CAP SCREW
(Abbreviated)	3/8 x 2-1/2" - 24 NF - HX HD CAP SCR

Rivets are used in farm equipment repair work to fasten together two pieces of metal which will not likely require disassembling later. Riveting is the "upsetting" of the end of the rivet shank which has been passed through punched or drilled holes in the metal pieces. "Upsetting" is the forming of a second head by shaping the end of the rivet in several ways while the head is held firmly in place ("bucked") with a bucking bar or dolly which is usually held by another person.

The most common types of rivet heads and rivets used are as follows:

Countersunk rivets are used where streamlining is necessary to prevent "drag" due to air or water flow and for appearance. The principle of countersinking used with wood and metal screws is used with rivets, permitting the head to be flush with the surface of the metal.

Brazier head rivets are used chiefly in aircraft assembling and repairing where countersinking is not practical and where "drag" must be kept as low as possible by making the rivet head thin.

Fasteners Used on Equipment
(Information Sheet continued)

Round head rivets are used where maximum strength is important and "drag" and appearance are of little concern.

Flat head rivets are used for general purposes where both strength and compactness are important. Tinner's rivets are of this type and are made of soft steel and are used tinned to prevent rusting.

The size of aluminum rivets is given in fractional inch sizes, usually in 32nds, and the length of the shank is usually expressed in 16ths of an inch.

Other types of fasteners are as follows:

Studs - A stud is threaded on both ends. One end is screwed into a threaded hole, and the other end receives a nut in the same manner as a bolt. In some cases the stud may be threaded from one end to the other.

Cotter Pins - Cotter pins or keys are used to fasten linkage ends by inserting the key through a hole on the linkage pin. These keys are used on clevis pins and castle nuts. The key prevents the castle nut from turning and prevents the pins from slipping out of pin holes.

Keys and Splines - Keys may be made in different forms to attach gears and pulleys to shafts. The shaft contains a slot, and the gear or pulley contains a groove for the pin. When the key is in place on the shaft and gear, both parts turn as one unit. Splines will allow longitudinal movement on the shaft, but the parts rotate as a unit.

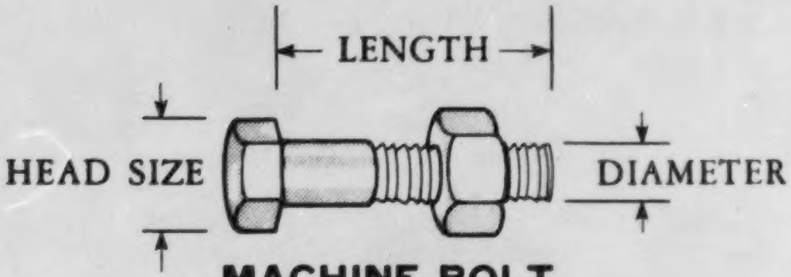
Locking Plates or Washers - This type of fastener locks the head of bolts and screws in place to prevent the bolt or nut from turning. Parts of the locking plate (tabs) must be turned up against the flat side of the screws.

Snap Rings - Many gears, shafts, and bearings are positioned (held in place) by snap rings. Internal or external snap rings are removed and installed by special tools.

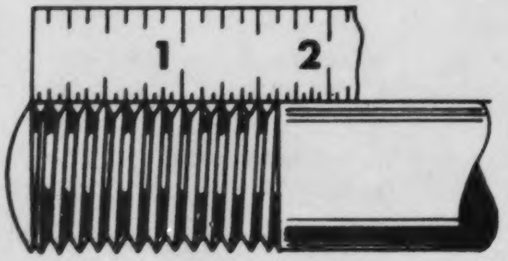
Setscrews - Most setscrews have either the common slotted screwdriver head or the Allen head. They are used mainly to lock pulleys in place. They may have pointed or cupped tips that are screwed down on the shaft.

Illustrated on the following pages are some common types of fasteners used in the farm equipment repair shop.

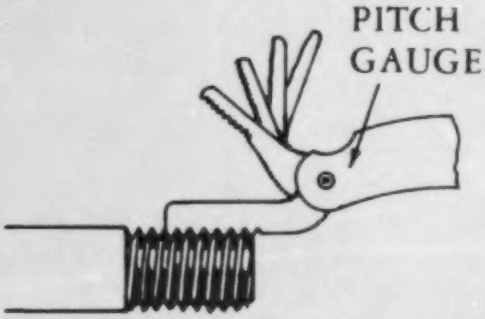
MACHINE FASTENERS


LENGTH
HEAD SIZE
DIAMETER

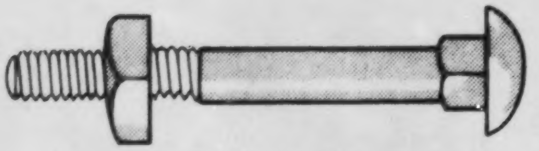
MACHINE BOLT



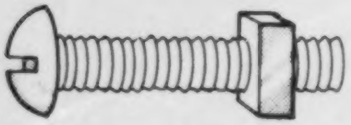
SCALE-THREADS PER INCH


PITCH
GAUGE

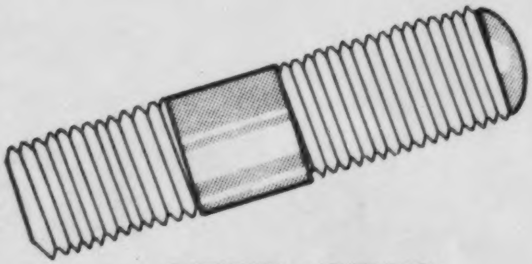
PITCH OF THREADS



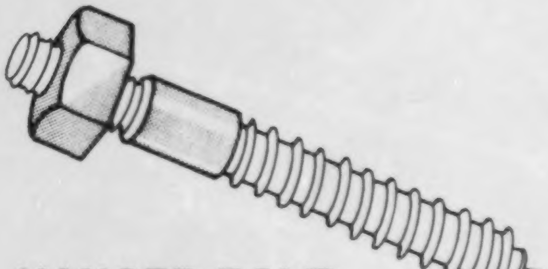
CARRIAGE BOLT



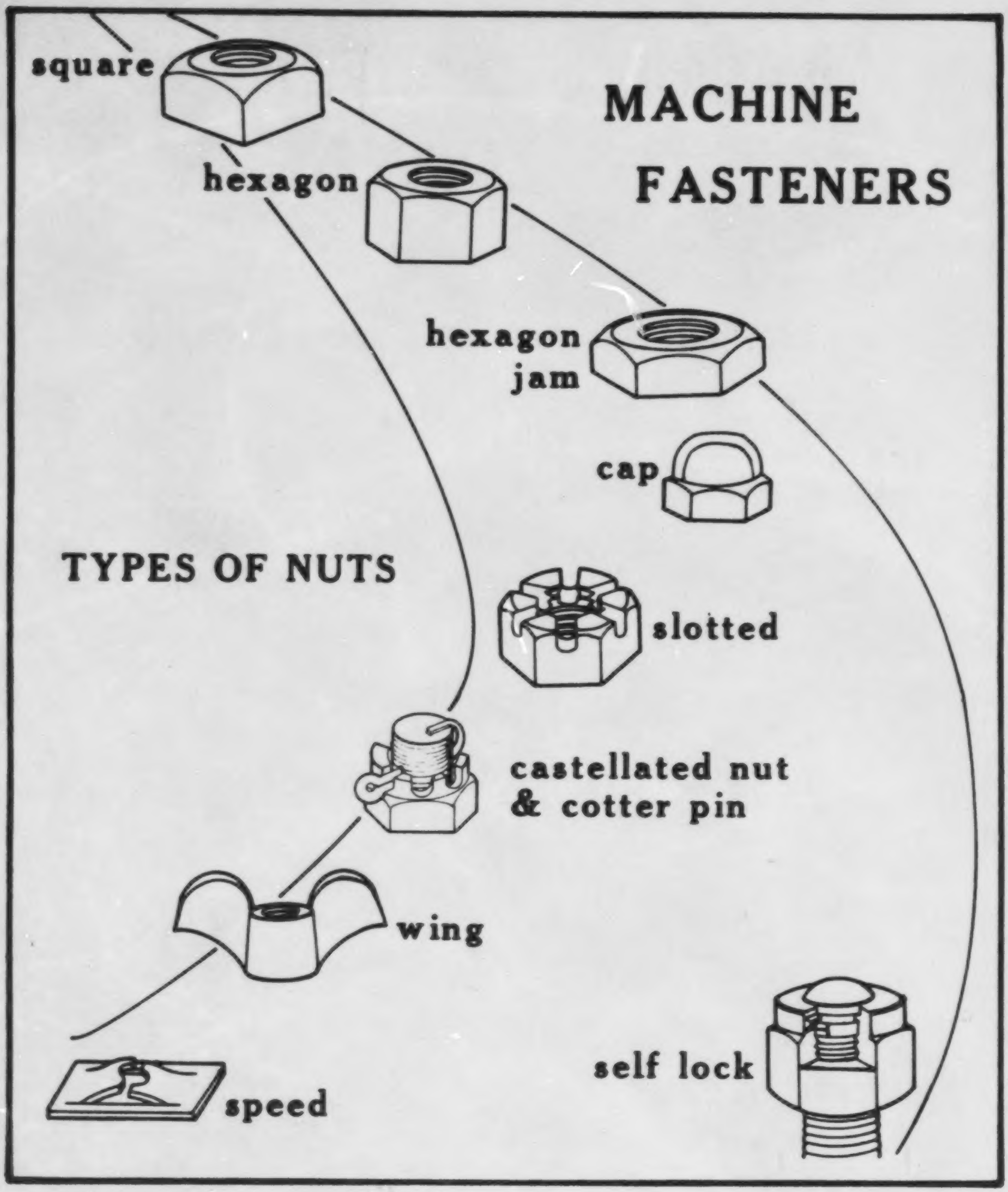
STOVE BOLT



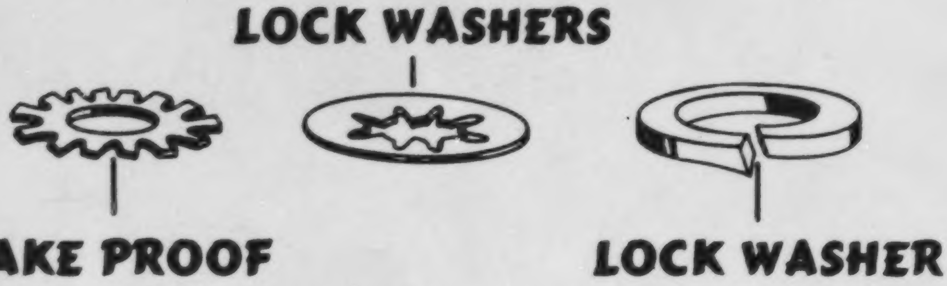
STEEL STUD

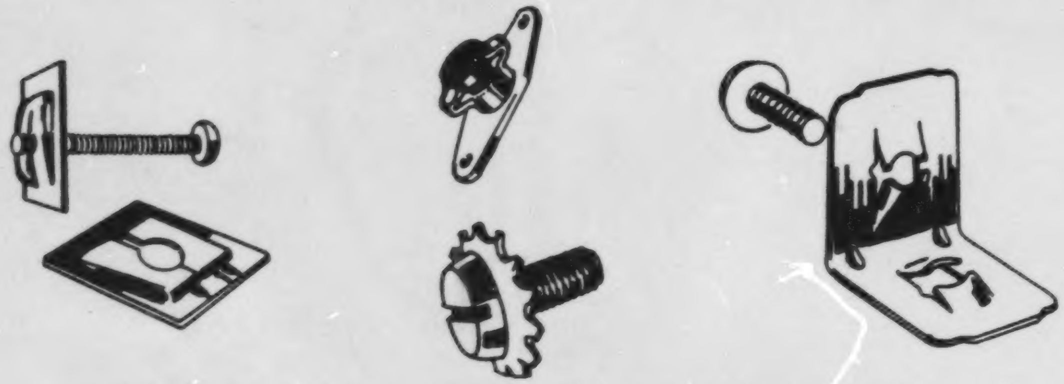


HANGER BOLT


MACHINE FASTENERS
TYPES OF NUTS
square
hexagon
hexagon jam
cap
slotted
castellated nut & cotter pin
wing
self lock
speed

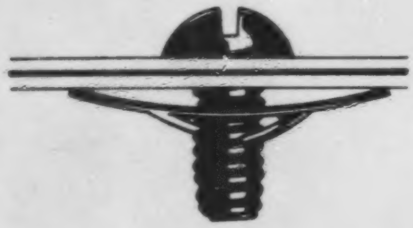
MACHINE FASTENERS


LOCK WASHERS
SHAKE PROOF
LOCK WASHER

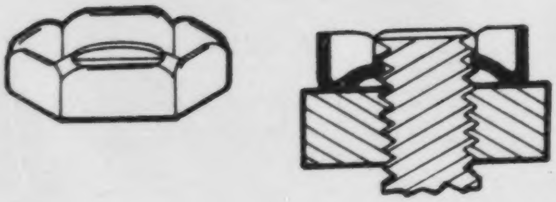


SPRING STEEL STALOCK FASTENERS

LOCK NUTS & WASHERS

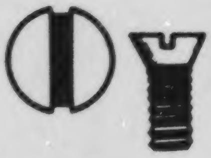


SPRING STEEL
LOCK NUT

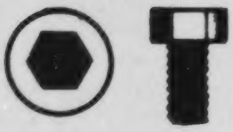


PALNUT

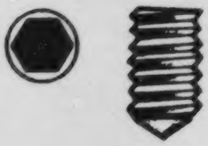
MACHINE FASTENERS



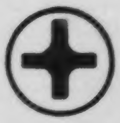
SLOTTED SCREW



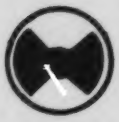
ALLEN SCREW



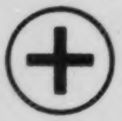
SET SCREWS



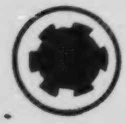
PHILLIPS
SCREW



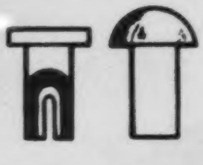
CLUTCH HEAD
SCREW



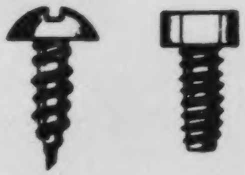
REED-PRINCE
SCREW



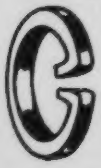
SPLINE
SCREW



RIVETS



SHEET METAL SCREWS



SNAP RING

Assignment Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Introduction

TOPIC: The Function and Types of Bearings Used on Equipment

OBJECTIVE: To be able to identify the types of bearings and understand their function.

REFERENCE:
Information Sheet, "The Function and Types of Bearings Used on Equipment"

QUESTIONS AND ACTIVITIES:

1. List the major types of friction and antifriction bearings.
2. What are the main functions of a bearing?
3. What is the purpose of most friction bearings?
4. How does the antifriction bearing differ from the friction bearing?
5. List the parts of a ball bearing and a roller bearing.
6. How are most bearings identified?
7. What are the most common terms used for parts of a friction bearing?
8. What are some common defects of friction bearings?
9. How are antifriction bearings usually removed?
10. What is the difference in force needed to pull equipment with friction bearings as opposed to that equipped with antifriction bearings?

Information Sheet
on
THE FUNCTION AND TYPES OF BEARINGS USED ON EQUIPMENT

Friction bearings have been successfully used since 1839 when Isaac Babbit first developed the machine bearing. Babbit bearings were made of a mixture of lead, antimony, and tin. These types of bearings are relatively soft. They are not as easily damaged by sand and metal particles as some other types of hard friction bearings, but they cannot withstand high temperatures and high loads as copper-alloy and aluminum-alloy bearings.

Bearings are developed to reduce both wear and friction by holding the various moving parts in position. They provide a surface that can be replaced when it becomes damaged or worn. Bearings extend the life of any piece of equipment that has moving parts, and they aid in proper functioning of machine parts.

The two major kinds of bearings are friction and antifriction. On equipment such as a disk, friction bearings are normally standard, roller bearings being optional. A piece of equipment that is equipped with friction bearings will take about one-fourth more force to pull than one equipped with roller bearings.

Friction - Friction bearings are referred to as bushings or plain bearings. There is a sliding contact or mating of two surfaces when this bearing is used. These are several types of friction bearings on modern farm machines. The most common are:

Split Bearing - This bearing is used on crankshafts of engines. It usually has a steel or bronze back that has a copper-lead, copper-tin, or a babbit lining. The split bearing is made to support thrust or radial loads.

Solid Bearing - Solid or sleeve bearings are made of brass, bronze, or copper. The strip is shaped into a bearing that resembles the solid bearing. It handles radial loads.

Thrust Bearing - The small part of this bearing resembles the solid bearing. It supports thrust and radial loads. Most of the thrust type bearings are made of bronze.

Split-Type Bearing - This bearing is either made of wood, plastic, cast iron, or sintered metal. It supports radial loads.

Rubber Solid Bearing - This bearing is found on a few farm machines. It is made with a rubber fluted inner part that is covered with a rubber outer part. It supports radial loads.

**The Function and Types of Bearings Used on Equipment
(Information Sheet continued)**

Other materials used to make friction type bearings are: aluminum, plastic, silver, wood, and a mixture of asbestos, phenolic resin, and cotton fabric.

Antifriction - The antifriction bearing uses a roller element of some type to reduce the friction. Generally, the rollers are placed between outer and inner rings. A separator or cage keeps the bearing apart and in place.

The load design of the three antifriction bearings are to handle radial, thrust, and a combination or radial and thrust loads. Radial (around the shaft) loads are handled at a right angle to the axis of the bearing. Thrust loads are handled parallel to the axis of the bearing, and a combination design handles loads from any direction.

The three basic types of antifriction bearings are: ball, roller, and needle. These three types are:

Straight-Roller - This bearing is made to handle radial loads. It is considered to be a high speed bearing. They may have more than one row of rollers.

Spherical Roller - This bearing will handle heavy radial and moderate thrust loads. These bearings are made in double and single rows.

Tapered Roller - This bearing is the most widely used of all roller bearings. It is made to handle radial and thrust loads. It is developed for high speed shafts.

Angular Contact - These bearings are made to handle heavy thrust or a combination of radial-thrust loads. The double row bearing is used on the transmission bevel pinion in tractors. The multiple row bearing can carry the thrust load in two different directions.

Self Aligned - This is a ball bearing with two rows of balls. It may be used on the transmission bevel pinion in tractors. The multiple row bearing can carry the thrust load in two different directions.

Needle - There are radial and thrust type needle bearings. For example, the radial bearing on a hydraulic steering pump prevents shaft deflection, and the thrust-load bearing prevents axial movement.

Most bearings can be identified by a code which includes the type, bore, O. D. (outside diameter) and width. Many types of bearings may have similar codes, but this does not signify that the bearings are alike.

The Function and Types of Bearings Used on Equipment
(Information Sheet continued)

The most common terms used for parts of the friction bearing are: back, lining, flanges, oil grooves, oil holes, location lug or dowel hole, and parting edges. The parts of an antifriction bearing are: outer ring, inner ring, face, cage, ball race, bore, ball or roller, and shoulder.

Bearings can be damaged very easily. Therefore, it is necessary to use every precaution possible to prevent defects. One of the most common causes of bearing damage is dirt. It will cause rapid wear, pitting, and scarring of the surface.

Some of the most common defects of antifriction bearings are:

> Spalling - Spalling is caused by small areas of the bearing flaking and falling off. The moving flakes (metal) damage the bearing.
>
> Brinelling - Brinelling is a series of grooves and ridges that cross the runway of the rollers. This condition generally starts from the lack of lubrication.
>
> Overheating - This condition is generally caused from improper adjustment or improper lubrication. The roller and bearing rings will have a blue or brownish blue color.
>
> Cracked Rings - This condition is caused by trying to force the bore on a shaft that is too large or a shaft that has been damaged.
>
> Dented Shields - Dented shields may be caused from the use of improper installation procedures. If the shields are badly dented, the bearing may reduce lubrication and cause the rollers to bind.
>
> Dented or Broken Cage - This condition may be caused by improper removal and installation practices. Worn cages caused by dirt and broken pieces of metal are very easily broken or damaged.
>
> Electrical Pitting - Some corrosion and wear are caused by electrical current.

Most friction type bearings are more easily removed than antifriction bearings. Also, the friction type bearing is more easily cleaned than roller, ball, and needle bearings. Antifriction bearings are usually removed either with a mechanical or hydraulic puller, a mechanical or hydraulic press, or a hammer with a driving tool.

After a bearing is removed it should be cleaned in a petroleum solvent or special cleaning fluid. It may be necessary to soak the bearing in order to loosen dirt and

The Function and Types of Bearings Used on Equipment
(Information Sheet continued)

grease. A short-bristled steel brush may be used to break dirt and grease loose from the bearing parts. After the brush is used on the bearing it should be rinsed again in the solvent. Antifriction bearings are soaked in solvent, brushed with a nylon brush, and the grease and dirt is blown out. Damaged or worn bearings are usually replaced. It is necessary that a new bearing be checked for size and well lubricated before it is installed. It may also be necessary to install bearing seals before and after installation of the bearing. The following procedure is used when inspecting and replacing the old antifriction bearing:

> Clean the bearing before it is removed with a solvent, and finish the cleaning process after it is removed.
>
> Remove excess solvent with air or a dry cloth.
>
> Repack bearing with the proper lubricant.

Friction bearings are normally used where close tolerances are important, as in the crankshaft of an engine where .003 inch may be the maximum allowance. If such close tolerances are important it stands to reason that proper care and handling must be used in the installation of the bearings.

Regardless of what type of bearing is being used the most important thing to consider when installing them is cleanliness. This is especially important in friction bearings where the smallest impurity, either on the surface or on the back, could ruin an otherwise successful repair job. Another important fact to remember is lubrication. When installing friction bearings it is imperative that they be coated with a high quality grease. This should insure adequate initial lubrication. After placing the bearing follow the manufacturer's specifications for proper assembly and torquing.

Assignment Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Introduction

TOPIC: Gaskets, Seals, and Sealants for Farm Equipment

OBJECTIVE: To understand the functions and learn the types of gaskets, seals, and sealants used on machines and equipment.

REFERENCE:
Information Sheet, "Gaskets, Seals, and Sealants for Farm Equipment"

QUESTIONS AND ACTIVITIES:

1. List eight of the most common types of materials used to make gaskets.
2. Why are gaskets placed between two or more parts of a machine?
3. List some of the factors that determine the types of gasket material to use.
4. Describe the types of material used on manifolds and cylinder heads.
5. Briefly explain some gasket installation problems.
6. When should a gasket be replaced?
7. What are the major functions of seals?
8. What factors should be considered when selecting a seal?
9. Describe the four major types of seals.
10. Give the main purposes of sealants used on equipment.
11. List the three main types of sealants.

Information Sheet
on
GASKETS, SEALS, AND SEALANTS FOR FARM EQUIPMENT

Gaskets are static seals that are made of such materials as steel, aluminum, copper, rubber, asbestos, cork, paper, plastic, or a combination of these materials. They are placed between two or more parts on a machine and are drawn together in such a manner that the joints are leakproof. The type of gasket material used will depend on the type of fluid or gas confined in an area, the temperature, smoothness of mating parts, pressures, and the construction or form of the mating parts.

Gaskets are used mainly on the engine parts of self propelled equipment. There are many types of gaskets used on engines and engine parts.

The top water outlet on an engine may have only a chemically treated paper type gasket. As the sealing task becomes more difficult, the construction of a suitable gasket becomes more involved and complex. The gasket used on exhaust manifolds must withstand very high temperatures, so it is usually constructed of steel and asbestos. The cylinder head gasket is probably the most complicated in terms of materials used and construction techniques. Unit pressure is very high, and combustion temperatures and pressures are tremendous. Also, the gasket must seal against coolant, oil, and corrosive gases. A metallic gasket is used on an engine cylinder head.

Gaskets may be bought in the following sets:

Head Set - This set of gaskets includes the necessary gaskets needed to replace the engine cylinder head.

Valve Grind Set - The valve grind set of gaskets furnishes all gaskets needed for doing a valve job.

Overhaul Set - The gasket overhaul set includes those gaskets needed for a complete overhaul job on the engine and other major parts. Delux overhaul sets are also available. This type of set contains more gaskets and seals than the overhaul set.

The most common types of metallic gaskets are:

Metal-Jacketed - These types of gaskets may have a core of asbestos covered with a metal sheet. They are used for engine cylinder heads.

Corrugated - The corrugated gasket is made of thin metal. It is installed with an asbestos cord fitted in the corrugation or with a gasket compound coat.

Flat Metal - The metal gaskets are cut from thin metal or sheet metal. They can be used over a wide temperature range.

Spiral-Wound - These gaskets are considered the best of all gaskets for recovering their shape. They are usually made of metal and asbestos.

Solid Metal - These gaskets are usually made from wire. When properly installed, the gasket provides a gas-tight seal. Sealing takes place by line contact caused by pressure or wedging.

Pressure Actuated - This light cross section gasket is usually installed with a metallic ring. They form a static seal when high temperatures, corrosion, and pressure are involved.

All gaskets must be properly installed. Otherwise, the gasket job will ultimately fail. Some gasket installation problems are :

Mating surfaces irregular or not true.
Pressure loss due to torque loss on the bolts.
Gasket shrinks causing the gasket to shift and break the seal.
Leaks develop at a corner or corners.
Gasket fails to fit the area.

Any time a gasket is removed it should be replaced with a new gasket. Many gaskets are in good condition when they are removed from a part on the machine, but they should be replaced with a new gasket.

Gaskets should be handled with care. New gaskets should be stored in a clean, dry area if they are not used immediately after purchase.

If paper or cork gaskets have shrunk due to storage, it is usually very easy to correct this situation by soaking in water for a few minutes. The gasket should be checked often while it is being soaked, as over-soaking may occur.

If a gasket is accidently cracked, torn, or damaged in some other way, it should be discarded and replaced with a new one.

There are many kinds of seals used on farm machines. They are one of the most important parts of a machine, because they prevent leaks of fluids and gases and keep out foreign material at joints and openings. Seals also separate units and parts of machines.

Seals are made for a specific part of the machine. The following factors should be considered when selecting a seal:

It should withstand certain pressures and heat.

It should fit the machine part. This will eliminate dragging on parts and reduce wear.

It should not be damaged by fluid or gas.

It should not damage polished metal parts on the machine.

It should have a number and name to facilitate its selection.

The major types of seals are:

Radial Lip - This type of seal is used to keep lubricants in systems where moving parts are found. It may be called an oil seal or shaft seal. The seal consists of a metal case and a sealing element which is usually flexible. These seals also have many lip designs; some are spring loaded.

Exclusion - Exclusion seals prevent dirt and other foreign material from entering moving parts of the machine. Some of these seals also function as inclusion seals. Their design may be in the form of a scraper, plain lip, boot, or tongue and groove.

Ring - Ring seals are found on pistons of an engine. The compression and oil control rings function as seals. Piston rings have a joint so that they can be spread apart for ease of assembly.

There are two types of ring seal: split-ring and circumferential. The piston ring is a split-ring seal. Circumferential seals are equipped with springs.

Face - Face seals are used on rotating shafts. Usually the sealing action takes place in a plane that is at a right angle to the shaft.

Compression Packings - These packings may be made of fabric, leather, metal, or plastic. They are usually in rectangular, round, or square form. They are squeezed between the throat of a stuffing box and another part or parts of the machine. Usually they are classed as inside and outside packings.

Molded Packings - There are two major types of molded packings - lip and squeeze types. Lip packings are made in the form of V-rings, flanges, cups, U-cups, and U-rings. The lip type is installed so that it can expand and contract. The squeeze type is usually fitted to a groove. It is used on hydraulic and pneumatic parts.

Diaphragm - A diaphragm is a seal that prohibits the interchange of fluid within a chamber or serves as a seal between a moving and stationary member on the machine. The two major types of diaphragms are rolling and flat. The rolling type may have a spring that provides a return to the original position or to help keep it in place. This type of seal is used where some pressure is involved in hydraulic piston operation.

The purpose of sealants are to contain or hold gases and liquids; protect equipment parts against dirt, moisture and dust; furnish a protective coating; hold gaskets in place; and reduce noise where parts are joined.

The types of sealants are:

Nonhardening - This type of sealant is somewhat soft after application. It may be applied with a brush or trowel to low-stress joints.

Hardening - There are two hardening types, flexible and rigid. Flexible sealants remain flexible after they are applied. Rigid sealants set up firm after they are applied to a surface.

Tapes - Tapes are considered as sealants because they are not cut to size. Tape is also used to cover seams.

Liquid or paste forms of sealants are applied by a brush, tube container, spray gun or can, and a spatula or mechanical spreader. Sealant is applied to butt, angle, and lap joints. A nonsagging sealant should be applied to vertical joints.

Assignment Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Introduction

TOPIC: Painting Equipment and Machines

OBJECTIVE: To understand the importance of cleaning and painting equipment.

REFERENCES:
Information Sheet, "Painting Equipment and Machines"

QUESTIONS AND ACTIVITIES:

1. List some reasons why it is important to paint equipment.
2. When is it necessary to use a wire brush and scraper on equipment?
3. Explain the cleaning of equipment parts by using the hot water tank method.
4. Why is the steam cleaning method used in many agricultural machine shops?
5. List the equipment, tools, and supplies needed to remove paint from metal.
6. Why do many repair shops use a spray gun for painting equipment?

Information Sheet
on
PAINTING EQUIPMENT AND MACHINES

Paint protects metal surfaces from corrosion and, in some cases, wear. It adds to the appearance of a machine. The value of the farm machine is partially maintained through a good painting program. Machines that are not properly housed during the season they are not in use must be protected by paint.

All types of farm equipment that are traded in on new equipment bring a higher value if the paint is in good condition. A well cared for surface may mean the entire machine is well cared for.

Proper cleaning of the machine and its parts is one of the most important jobs that is performed while repairing farm equipment. Improper cleaning usually means an improper overhaul or repair job. If the equipment or any of its parts are to be painted, the paint will not adhere to greasy, dirty surfaces. There are several different methods or techniques used to clean farm equipment and parts. These techniques are:

> Wire Brush and Scraper - Cooked on accumulation of oil on the exterior of engines and other parts must be cleaned with scrapers and power brushes. Power brushes are not used on soft parts. Wash part or parts in solvent after cleaning with brush and scraper.
>
> Parts Washer - Used for washing small parts. Many cleaning solutions may be used in parts washers. Many cleaning solutions are dangerous and should be used with care.
>
> Hot-Tank Cleaning - A strong alkaline compound is usually mixed with water and the solution heated from 180 to over 200 degrees F. Clean water is used to rewash equipment parts after they are placed in the alkaline solution.
>
> Steam Cleaning - There are many different steam cleaners on the market. It is important that the manufacturer's recommendations be followed when using this type of equipment. This is one of the best ways to remove most oil and dirt deposits. A solvent may be used to remove an oil film when using this cleaning method.
>
> High-Pressure Spray Cleaning - This piece of equipment may use cold water under high pressure with cleaning compound injected. Some manufacturers have models with a heating coil so that water may be heated to about 160 degees F. higher than the source.

Painting Equipment and Machines
(Information Sheet continued)

Low Pressure Spray Cleaning - In this method an air operated mixing gun is used. The cleaning solution is sprayed on and then the object being cleaned is either washed down with a water hose or the mixing gun.

Cold Soak Cleaning - Parts are placed in a basket or container and lowered into a cleaning solution. After a specified amount of time the parts are washed off with water and air dried.

Vapor Cleaning - Cleaning may be accomplished by heating a solution so that the vapors deposit on the parts. The solution is not flammable.

Sand Blast Cleaning - The sand blast is not used for cleaning parts but may be used for cleaning before painting. Most shops do not use this method of cleaning.

The equipment, tools, and supplies usually used in removing paint from metal includes an air compressor, putty knife, wire brush, emery cloth, steel wool, and a screwdriver. The surface is treated with a caustic compound (paint remover) and is steamed or treated with another cleaning solvent. In some instances a blow torch is used to remove old paint. After the surface is free of old paint, it is sanded and a priming coat is added. It is advisable to complete all repair work before painting a piece of equipment.

A mechanical means of applying paint is used by manufacturers who make farm equipment, trucks, automobiles, tractors, and many other types of machinery found around the home and farm. Spray painting is similar to brush painting in that it improves the appearance and life of an item, thus making it more valuable.

There is little comparison in the cost of spray painting and brush painting equipment. If there is much painting to be done, the labor required to brush paint will offset the cost of good spray painting equipment.

Spray painting is the best way to paint farm machinery.

An area or piece of machinery can be painted more rapidly with a spray gun than with a brush. It is estimated that a spray gun will cover five to twenty-five times the area that can be covered with a brush in the same period of time. This is one reason why farm machinery repair shops and manufacturers use the spray gun instead of the paint brush.

The advantages of applying paint by spraying are:
1. Saves time
2. Smoother finish
3. Enables corners and cracks to be filled
4. Enables wide application of finishes with the same equipment
5. Makes painting of rough surfaces faster, easier, and simpler

Assignment Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Introduction

TOPIC: Importance of Welding and Identification of Metals

OBJECTIVE: To develop an understanding of the importance of welding for repairing farm equipment. Also, to be able to identify metals used in the manufacturing of equipment.

REFERENCE:
Information Sheet, "Importance of Welding and Identification of Metals"

QUESTIONS OR ACTIVITIES:

1. Why is a welder so important in a repair shop?
2. What can the oxyacetylene flame be used for other than welding?
3. Define arc welding.
4. What is the difference between the energy used when arc welding and that used when oxyacetylene welding?
5. What is the meaning of the American Welding Society class number E 6013?
6. What is the most common type electrode used for repair work?
7. List some types of metals found on farm equipment.
8. In what way does bronze welding resemble soldering?
9. What are the weaknesses of bronze welding?
10. List the common welding positions used in a shop.
11. List some common types of repair joints.
12. List the special uses of an arc welder.

Information Sheet
on
IMPORTANCE OF WELDING AND IDENTIFICATION OF METALS

Two of the most important pieces of repair equipment in a farm machinery shop are the arc and oxyacetylene welding units. The reasons why this type of repair equipment is so important are as follows:

> Repairs can be made rapidly on farm machinery and equipment, which is good insurance during harvest time and other critical periods.
>
> Minor cracks or breaks can be repaired before they cause a major repair problem.
>
> Metal repair and construction jobs may be accomplished more economically with an arc welder than with other types of metal repair and construction equipment.
>
> The arc welder can be used for jobs that require cutting, piercing, gouging, beveling metal, and welding most metals if the proper type rod is used.
>
> The oxyacetylene flame is used to weld iron, steel, brass, copper, aluminum, cast iron, and special alloys. It is also used extensively for cutting metal, annealing, and hardening.
>
> An oxyacetylene welding and cutting outfit is considered a very useful tool for the modern farm and ranch. It is used to build equipment and do repair jobs. When repairing equipment, oxyacetylene flame may be used to heat metal for bending, forming, straightening, hardening, tempering, and removing paint and rust on equipment.
>
> Arc welding may be defined as the process of fusing two or more pieces of metal together by using the heat produced from an electric welding machine. The arc, struck between the carbon electrode and the metal, heats the metal to a melting point, then the electrode is removed to break the arc and let the metal freeze.
>
> A flame (arc) of intense heat is generated as the electric current passes through a highly resistant air gap. The air gap is the space between the lower tip of the electrode and the base metal.

Oxyacetylene welding is the jointing of two or more pieces of metal together by heating them to the melting point provided by combustion of a gas mixture, oxygen and acetylene. The fusion process can be accomplished with or without the use of a welding rod.

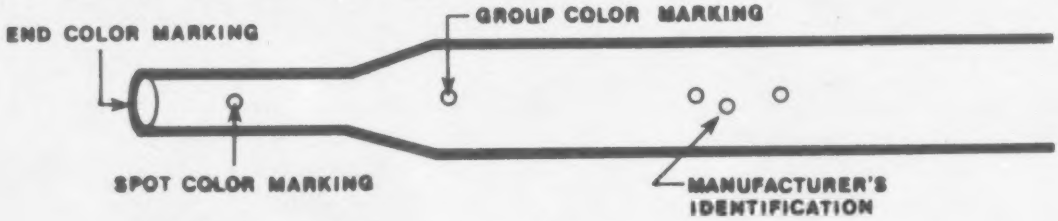
Importance of Welding and Identification of Metals
(Information Sheet continued)

Oxyacetylene cutting is the process of separating metal by heating it to a kindling temperature (burning temperature) of about 1,800 degrees F., then oxidizing and blowing the metal from the cut.

It is important that the correct size of electrode and welding rod be used to make a good repair job. The size and type of electrode to use is based upon the kind of metal, its thickness, and, in some instances, the type of weld used. The size of electrode will usually determine the amperage setting.

All major manufacturers of welding electrodes use the code of specifications prepared for testing materials by the American Welding Society (AWS). There are several manufacturers of electrodes; and each company makes basically the same quality, if they follow the AWS specifications.

ELECTRODE IDENTIFICATION



The meaning of the AWS class number (E6013) is:

E - The electrode for electric arc welding.

60 - The tensile strength of the electrode metal (psi). Example; 60 x 1,000 or 60,000 pounds per square inch.

1 - Weld flat, horizontal, vertical, and overhead. If the third number is a 2, it can be used for flat and horizontal welding, but a 3 means flat only.

3 - May mean the chemical analysis of the flux, the polarity of the electrode, AC or DC rating, or the penetrating capacity of the electrode. The # 6011 will penetrate deeper and have less slag than a # 6014 electrode.

The actual size of an electrode is determined by the bare end of the rod.

Approximate Amperage Setting	Size of Electrode	Thickness of Metal
65	3/32"	1/16"
80 - 100	3/32"	3/32"
80 - 110	1/8"	1/8"

Importance of Welding and Identification of Metals
(Information Sheet continued)

Approximate Amperage Setting	Size of Electrode	Thickness of Metal
115 - 130	5/32"	3/16"
130 - 150	5/32"	1/4"
140 - 150	5/32"	5/16"
160 - 175	5/32"	3/8"
175 - 200	5/32"	1/2"

One of the main purposes of the flux on an electrode is to furnish a gaseous smoke screen to envelop the arc and protect the molten metal from harmful atmospheric effects of nitrogen and oxygen. The flux coating that does not burn to form the gaseous shield mixes with the metal impurities and settles as slag on the welded metal.

The types of electrodes include mild steel, cast iron, alloys, hardsurfaces, and high-carbon steel. One of the most commonly used types is mild steel. Two of these electrodes are: E 6011 or E 6013 - AC Welder; E 6010 - DC Welder

When welding with oxyacetylene, the size of tip, rod size, and thickness of metal must be considered as very important welding factors. Tips are made in various sizes to provide different degrees of heat. The amount of heat increases as the size of orifice (drill size of a hole in the tip) increases. The neutral flame will remain at about 5,900 degrees even though the quality of heat may change.

Listed below are the approximate sizes of tips and rods to use when welding steel with steel or bronze rods.

Tip Size (Orifice)	Rod Size (Inches)	Thickness of Metal (inches)
74	1/16	1/32
69	1/16	1/16
64	3/32	3/32
57	1/8	1/8
55	3/16	3/16
52	3/16	1/4
49	1/4	5/16
45	1/4	3/8
42	1/4	1/2

Farm equipment and machines are constructed of different types and thicknesses of metals. It is therefore necessary to be familiar with the many welding processes in order to be a successful repairman. General procedures used to weld equipment metals are as follows:

Heavy Steel Plate - There are many places on farm equipment where steel over 1/4 inch thick is used. Welding heavy steel plate requires knowledge and skill in handling a large amount of heat, large puddle, and a large amount of filler metal. Welding thick steel is also different from welding thin steel. Joints should be beveled; multi-lay welding is required for larve vees; good fusion must be maintained up the sides of the vee; and a different welding technique (backhand) may be used.

Gray Cast Iron - Many machine parts are made of cast iron. For example, some gears, frames, gear boxes or housings, and engine blocks are made of gray cast iron. The oxyacetylene welding procedure is commonly used to repair cast iron parts.

Aluminum - Aluminum and aluminum alloys are used in the manufacture of equipment and machine parts. Aluminum differs from other metals by oxidizing at higher temperatures, melting before it changes color, conducting heat faster, and shrinking more on cooling than cast iron. It becomes very weak near melting temperature.

The characteristics of a good steel joint weld apply to welding an aluminum joint. These characteristics are:

Proper fusion
Proper penetration
Weld in line with seam
Proper crown
Clean appearance

Sheet Steel - Many farm machines and equipment bodies are made of sheet or very thin steel. Cracks and torn places on combines, balers, tractors, trucks, and many other types of machines may be repaired by the oxyacetylene welding process. The welds can be as strong as the base metal when properly made. Regardless of the thickness of the metal, it is advisable to use a filler rod in order to obtain a strong weld.

Most repair and rebuilding jobs on farm machines can be accomplished by bronze welding. It is a convenient way to join steel, malleable steel, cast iron, and several other metals together. Bronze welding is very frequently referred to as bronze welding or brazing.

The American Welding Society defines braze welding as "a method of welding whereby a groove, fillet, plug, or slot weld is made using a nonferrous filler metal, having a melting point below that of the base metals, but above 800 degrees F. The filler metal is not distributed in joint capillary attraction."

Bronze welding resembles soldering in that the base metal is not melted together with the bronze metal. There is a strong bond formed between the base and rod metals in a proper weld.

The advantages of a bronze weld are:

Lower welding temperatures are needed; therefore, time and gas are saved.

Due to the low temperature used to make a bronze weld, there is less chance of changing the base metal characteristics. For example, expansion and contraction are not as great where less heat is required.

Less preheating is used in bronze welding than wrought or cast iron welding.

Bronze welding is adaptable to many kinds of metal.

The disadvantages of bronze welding are:

Bronze tends to lose its strength if subjected to temperatures above 500 degrees F.; therefore, parts on a machine that operate at high temperatures should not be welded with bronze. The filler rod is made up of a copper and zinc with small quantities of silicon, tin, iron, and manganese.

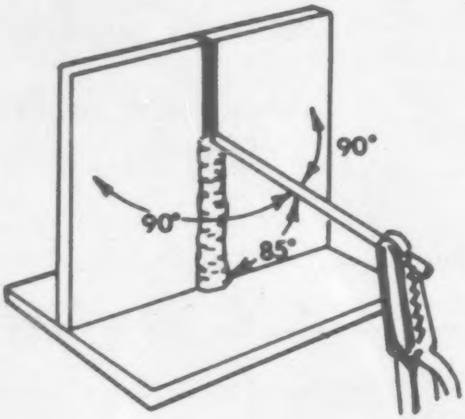
Another type of welding used in the repair shop is hard surfacing. It is sometimes called hard facing, because a layer of wear-resistant metal is applied to the surface or cutting edge of an equipment part to increase its life. The cutting edges of plow shares and sweeps are hard surfaced to prolong the life and maintain a sharp cutting edge.

The most common welding position used to repair farm machinery is the flat position. Other positions are vertical up, vertical down, horizontal, and overhead (Figure 1).

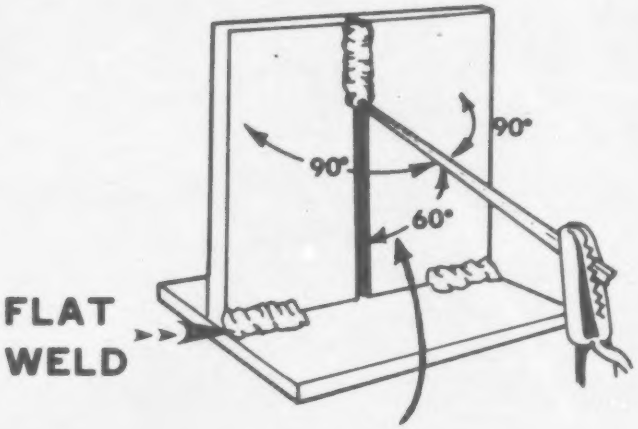
The most common types of repair joints are: single and double bevel butt, square butt, and T-joint. Heavy steel is beveled before welding, whereas sheet steel remains square or unbeveled (Figure 2).

The arc welder may be used for cutting, piercing holes, gouging (forcing electrode to form indent in metal), and beveling. This type of work can be accomplished more easily with the oxyacetylene cutting torch (Figure 3).

WELDING POSITIONS

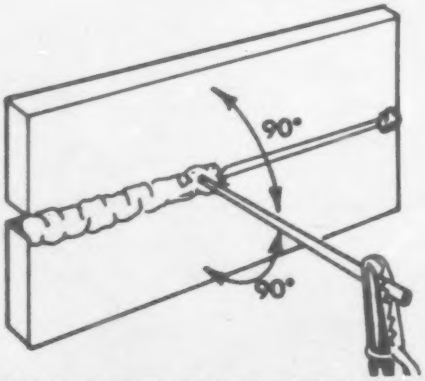


VERTICAL UP


90°
90°
60°
FLAT WELD

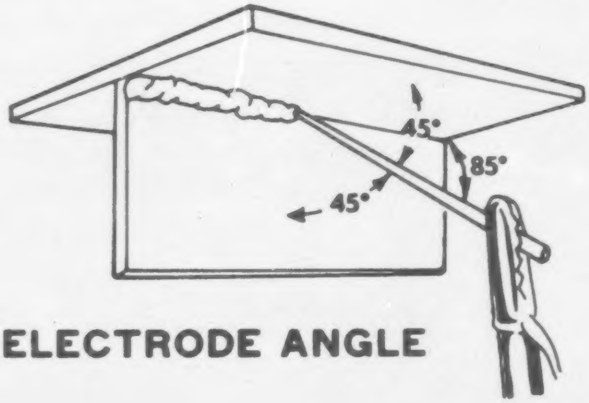
VERTICAL DOWN

HORIZONTAL WELDING



PROPER ELECTRODE POSITION

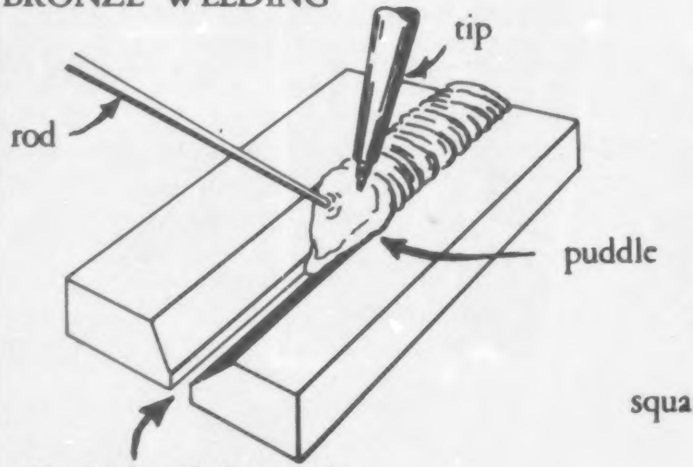
OVERHEAD FILLET WELD



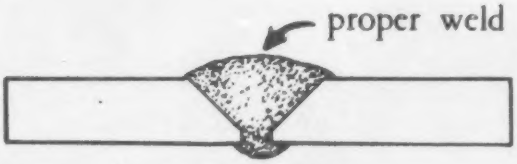
ELECTRODE ANGLE

Types of Welds and Joints

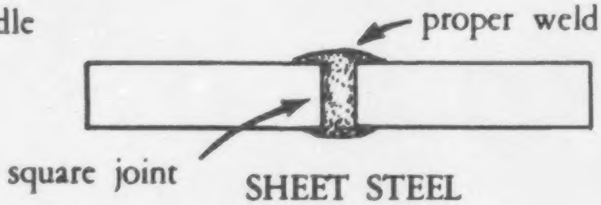
BRONZE WELDING


tip
rod
puddle

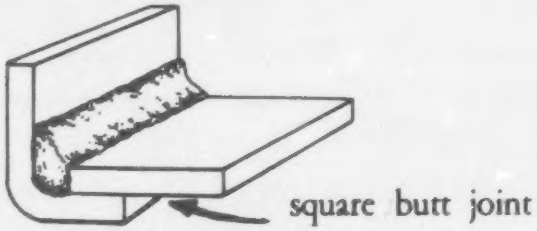
Single bevel Butt Joint


proper weld

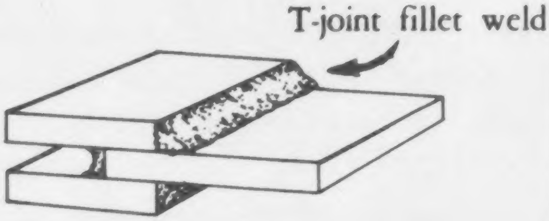
HEAVY STEEL


proper weld
square joint

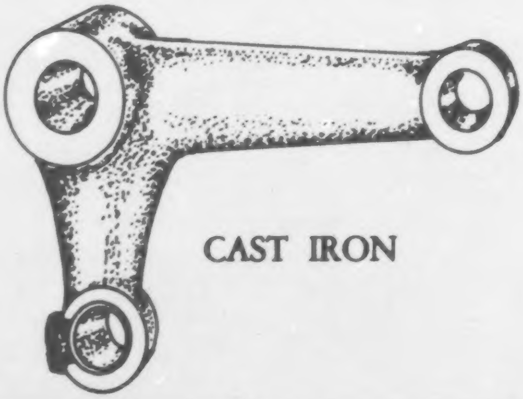
SHEET STEEL


square butt joint

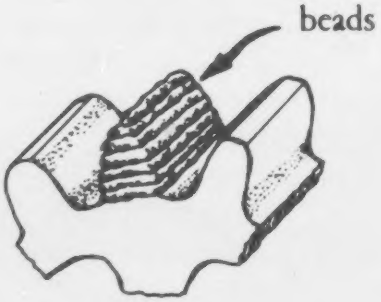
FLANGED BOTTOM


T-joint fillet weld

DOUBLE LAP

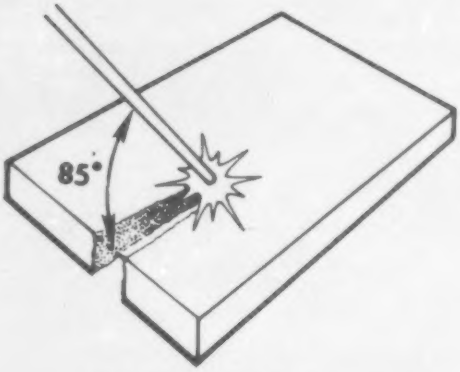


CAST IRON

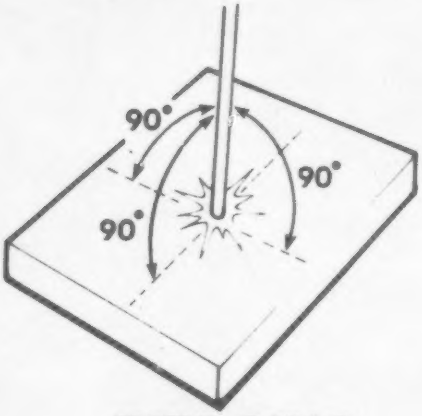


TOOTH IN GEAR

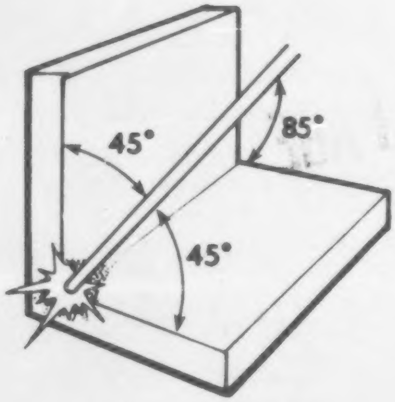
OTHER USES OF THE ARC WELDER



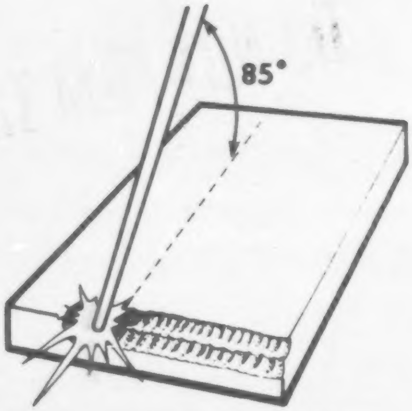
CUTTING



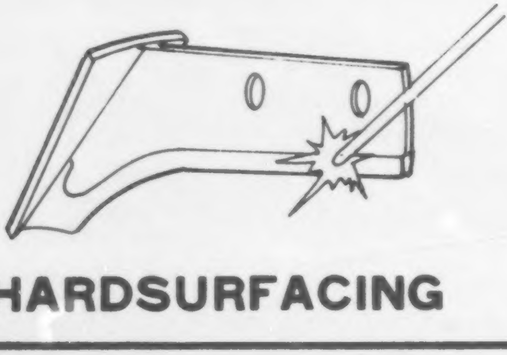
PIERCING



GOUGING



BEVELING



HARDSURFACING

Assignment Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Introduction

TOPIC: Tires and Wheel Rims

OBJECTIVE: To develop an understanding of tire types, construction, codes, and maintenance practices. Also, to develop an understanding of the types of wheel rims and the use of wheel weights.

REFERENCES:
Information Sheet, "Tires, Wheel Rims, and Wheel Weights"

QUESTIONS AND ACTIVITIES:

1. List the vital parts of a tire as found in Figure 1.
2. Briefly describe the tire bead and give its function.
3. What are the materials found in the body plies of tires?
4. Where does the tire sidewall receive its rigidity?
5. Explain the meaning of belted bias ply and belted radial ply.
6. What are the purposes of a good tread?
7. What is the code for each of the following types of tires: rib tread, traction tread, plow tail wheel, and smooth tread?
8. Give the effects of under-inflated tires.
9. What causes tire cuts, moisture damage, sidewall damage, and heat damage?
10. List the four types of tractor and implement rims.

Information Sheet
on
TIRES AND WHEEL RIMS

Until the early 1930's farm tractors and equipment were equipped with iron and wood wheels which were covered with steel bands. Rubber tires gradually replaced these wheels. The farmer or purchaser had a choice in the 1930's between steel wheel and rubber tire tractors. The reasons that rubber tires replaced iron wheels on tractors are:

They gave better fuel economy.
Better service from the drawbar in higher gears could be attained.
Rear wheel weight could be adjusted easier.
Tractors could travel at a higher rate of speed with light loads on hard surfaces.
Tractor wheels no longer damaged hard surfaced roads.
Tractors moved longer distances under their own power.

A cut away drawing helps to see the tire's vital parts (Figure 1).

Beads - The beads anchor the tire and rim together and are the foundation of the tire. All of the tire plies are tied to the strong bundle of wire, which is the bead, to prevent any change in shape or in the fit on the rim.

Body Plies - Layers of rubber-cushioned fabric or cord make up the body. The built-in strength in this part of the body holds in inflation and cushions shocks. Each cord in every ply is surrounded by a resilient rubber compound. This cord may be of rayon, nylon, cotton, polyester, or other materials. Nylon and rayon are the most popular, but polyester is coming into more common usage.

Ply Rating - All off-the-road tires are ply rated. The ply rating was used formerly to tell how many actual plies the tire had. Now it identifies a given tire with its recommended load when used in a specific type of service.

As a comparison of 2 and 4 ply construction, to get the same strength, the two ply cords are larger than the 4 ply cords.

Bias Ply - In the normal tire, ply cords run from one tire bead to the other at an angle. Alternate plies run in opposite directions; the construction gives rigidity to the thread and sidewall.

Belted Bias Ply - The tire body is similar to the bias tire, but the body is surrounded by a semi-rigid belt. These belts are made up of very low angle cords which surround the tire body under the tread. These belts help give a more rigid sidewall and tread life.

Belted Radial Ply - The body cords run across the body from bead to bead almost at right angles. Fairly rigid cord belts surround the tire body under the tread. This construction gives better tread life and better tread support.

Wire-Reinforced Ply - On some large tires for earthmoving or other heavy equipment, a layer of wire is built in between the body and tread of the tire. This protective layer of wire keeps most cuts from penetrating into the tire cavity, keeps many tread cuts from growing, and tends to keep cuts closed so that sand and dirt will not enter and foster separation.

Sidewalls - The rubber coverings on both sides of the body are called sidewalls. These are designed to flex and bend without cracking when used under normal and extreme sudden shock.

Tread - The tread is the part that contacts the road or ground. In most cases it must provide traction, resist cuts, and provide long wear.

Tubeless Inner Liner - This covers the inside from bead to bead. This liner will serve as an air retainer.

Flaps - Used on tube type tires, the flap protects the tube from injury if it should contact the rim or tire beads.

Many types of tires are in use, especially in agriculture. To simplify things, a uniform code has been adopted by both the Tire and Rim Association and the Rubber Manufacturer's Association (RMA). The standard code is marked on the side of the tire, and it normally consists of a number plus a letter. As an example, in R-1, the letter R means it is a rear tire. The number that follows tells the specific type of rear tire.

Some tire manufacturers will add the letter "O" after the industry code to show the tire has open tread design. They may also add the letter "C" to indicate a closed tread in the R-2 classification. Drive wheel tires may have an arrow showing the way the tire is to rotate.

There are many common terms used to classify farm equipment tires. Such terms as "first line", "second line", "top grade", and "100 level" are common terms used in the tire business in reference to quality. The quality of the various makes of tires cannot be compared by using these terms. The "first line" tire of one company may be better or lower in quality than a "first line" tire of another company. Also, different makes of tires that sell for about the same price may or may not be of the same quality. The types of implement tires of various grades may be identified as follows:

Rib tread	I-1
Traction tread	I-3
Plow tail wheel	I-4
Smooth tread	I-6

Proper inflation of tires at all times in all seasons is important (Figure 1). It is important to have an accurate pressure gauge. There are high and low pressure gauges. Usually, a high pressure gauge is not satisfactory for checking low pressure, since they are usually marked in 5 pound increments. Low pressure gauges are marked off in one-pound increments.

The effects of improper inflation are as follows:

Underinflation	Overinflation
Severe stress on sidewalls causing cracking	Excessive wear especially on edge of tread bars
Excessive wearing of tread on each side of tire due to cupping	Excessive wear in center of tire
Excessive wear on shoulders caused by rim bruises	Possible fabric damage if tire hits hits sharp object
Twisted or broken valve stems	Tire slips on certain surfaces easily
Powered equipment difficult to steer	Tread fails to clean when traveling in certain type of soil
Tire loose on rim causing it to slip	Equipment ride is rough

Usually, underinflation is considered to be more damaging to a tire than overinflation. A two to four pound loss of air pressure may produce a high percentage of underinflation.

The recommended air pressure depends on the tire size, ply, and its location. Even though a rear tire is larger, it carries less air pressure than a front tire.

Other tire damages are:

Tire Cuts - The most common cuts found on a tire are caused by machinery coming in contact with the tire. A tractor that is turned short may bring the equipment it is pulling in contact with the wheel. A loose fender, fender brace, shield, and many other parts on the tractor and equipment can cut the tire. Some tire cuts are caused by the tire passing over an object with a sharp edge.

Moisture Damage - Moisture causes the inside of the tire to become brittle and weak. It also causes the fabric to rot. Tire cords will break easily if they are exposed to moisture over a long period of time.

Sidewall Damage - Overloading causes tearing of the sidewalls. In some cases the fabric breaks down and the bead wire is pulled out. Bead wires may be pulled loose by the improper use of the tire tool.

Heat Damage - Equipment tires are made for slow moving (maximum speed of 20 miles per hour) machines. If tractor and equipment travel at high speeds, high temperature can develop under the tread which may weaken the cord fabric and rubber. Heat damage develops when equipment is towed at a high speed.

Hard surface roads and low pressure will cause tire distortion, and the tread bars will squirm and wear excessively. If the tires are to be used excessively on hard surface roads, the pressure should be increased to manufacturer's maximum recommendations to help prevent the wear. When the tire is put back into field work, air pressure should be released so the tire to ground contact will again be proper.

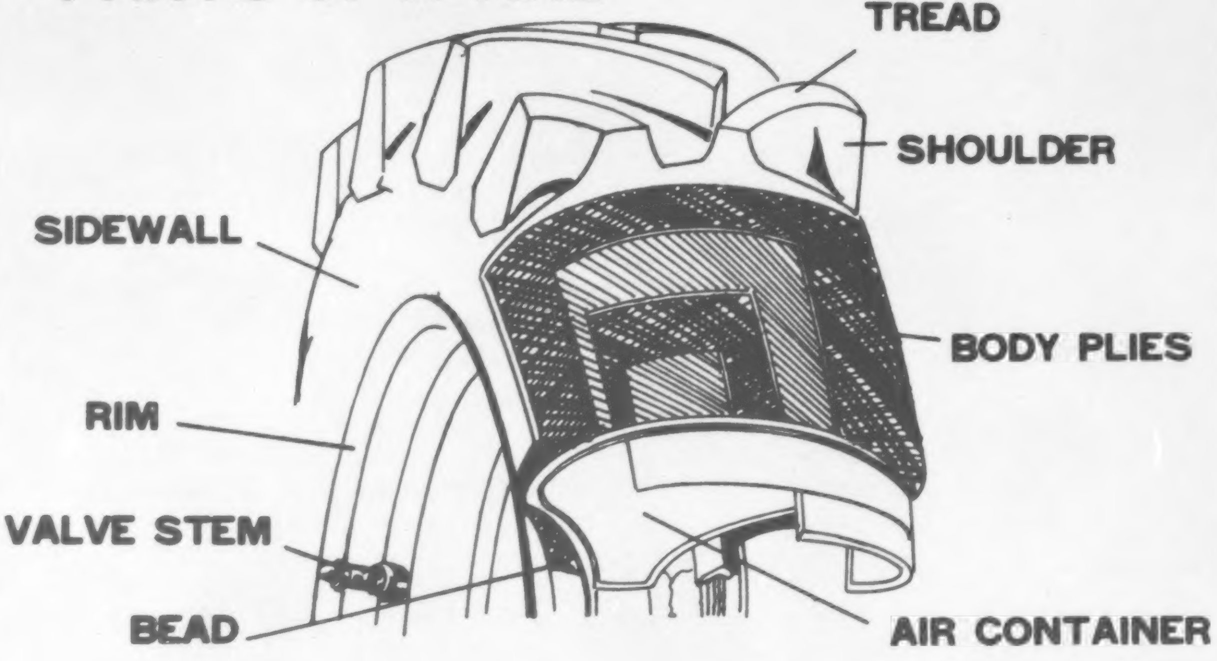
It is important that wheel rims be properly cared for when the equipment is operating and when not in use. Rims that are dented, out-of-round, or showing sharp edges at the tire bead can cause excessive tire wear and damage. Tractor and implement rims are made in many shapes. Most implement and tractor rims use a tube with the tire, but some rims and tires are made to be operated without tubes.

There are three measurements used to determine rim size. They are: rim diameter, rim width, and rim flange height. The diameter and width of a rim is measured in inches. The height is identified by letters (H.I.). The flange will indicate a certain flange height (Figure 2).

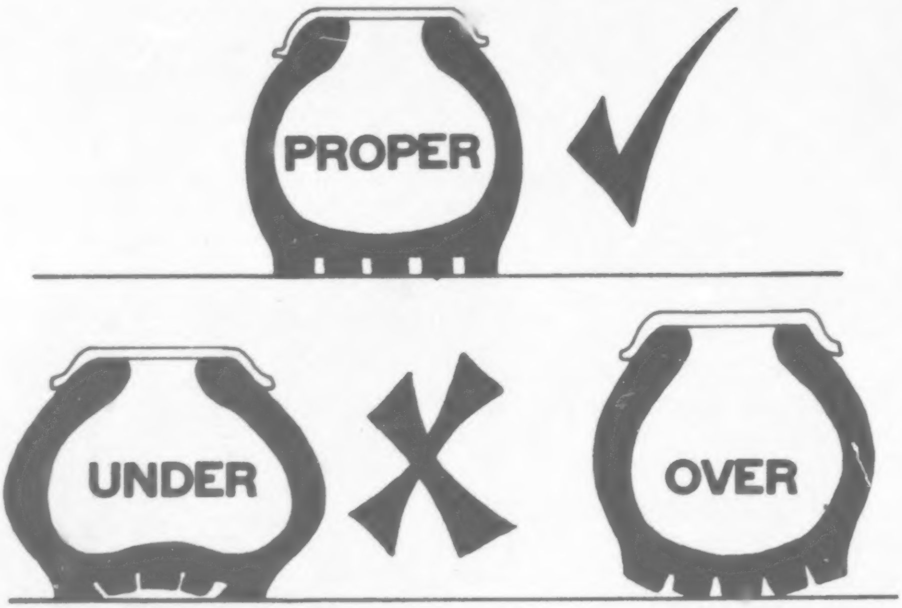
Four types of tractor and implement rims are:

Wide base drop center rims
Double bevel drop center rims
Deep well drop center rims
Drop center rims for front wheels of tractor and implements

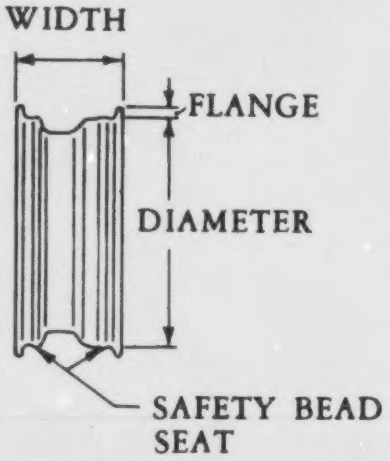
PARTS OF A TIRE


TREAD
SHOULDER
SIDEWALL
BODY PLIES
RIM
VALVE STEM
BEAD
AIR CONTAINER

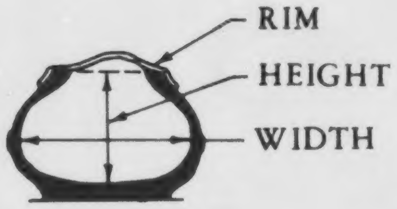
TIRE INFLATION


PROPER
UNDER
OVER

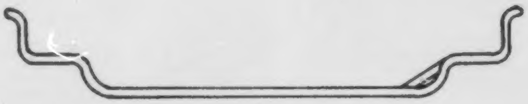
WHEEL RIMS


WIDTH
FLANGE
DIAMETER
SAFETY BEAD SEAT

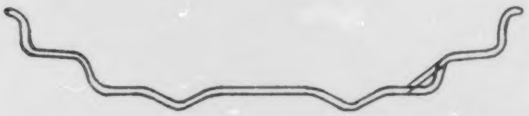
RIM MEASUREMENTS


RIM
HEIGHT
WIDTH

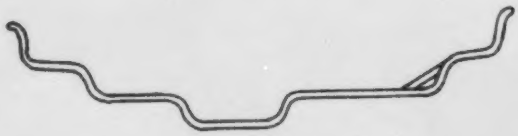
TIRE MEASUREMENTS



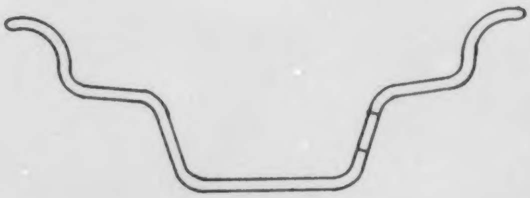
WIDE BASE RIM



DOUBLE BEVEL RIM



DEEP WELL



DROP CENTER
(TRACTOR FRONT
& IMPLEMENTS)

Assignment Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Introduction

TOPIC: Tubing and Hoses

OBJECTIVE: To develop an understanding of the types of tubing and hose used on machinery and equipment.

REFERENCES:
Information Sheet, "Tubing and Hoses"

QUESTIONS AND ACTIVITIES:

1. How are hoses used on farm equipment?
2. List the units, systems, or parts that use tubing and/or hoses on self propelled equipment.
3. What is the function of tubing and hoses on machinery?
4. Explain the use of plastic tubing.
5. What are the three basic types of tubing connections?
6. List the typical pipe fittings.
7. List the different types of hydraulic hoses according to pressure.
8. What are the parts of a high pressure hydraulic hose?

Information Sheet
on
TUBING AND HOSES

Tubing and hose are found on many parts of farm machines. Hydraulic units which are found on drag type equipment are composed of tubing, hose, valves, and cylinders. This type of unit is used to raise and lower equipment, operate equipment at certain soil depths, and to brake equipment. On self-propelled equipment tubing and hose are found on the braking system, steering system, air conditioning system, lubricating system, fuel system, cooling system, and instrumentation system.

The functions of tubing and hoses are to transfer fluids and gases, create vacuums, and transfer air.

Normally steel and copper are used on most farm machines, but aluminum and plastic tubing is being used on certain parts. Copper tubing is not used for brakes and power steering. Special treated steel tubing is used for this purpose. Plastic tubing will not carry high pressures and excessive heat. Plastic tubing may be used for fuel, vacuum, and some lubrication lines. Aluminum tubing will break under continuous vibration.

The three basic types of tubing connections are as follows:

> Flare - The end of the tubing is spread (flared) outward at an angle. The angle of the flare may be 37 or 45 degrees. The flare may be single or double lap. The double lap flare is used on double wrapped brazed steel tubing (Figure 1).
>
> Compression - A sleeve is compressed against the tubing as the body fitting and nut are screwed together. Compression fittings are not used on high pressure lines such as power brakes or steering. This type of fitting may be used on most fuel and lubrication lines (Figure 1).
>
> Pipe Fittings - Pipe fittings have tapered threads which make a leakproof joint when tightened on tubing or pipe. They are used to branch lines or connect two or more lines, attach tubing to the brake cylinder, and connect tubing or pipe to other parts of the machine. The typical fittings are: connectors, elbows, unions, T-fittings, bushings, plugs, nipples, distribution blocks, and valves (Figures 1 &2).

The most important use of hose on equipment is its use on the hydraulic system. The base material for hose is rubber that has been reinforced.

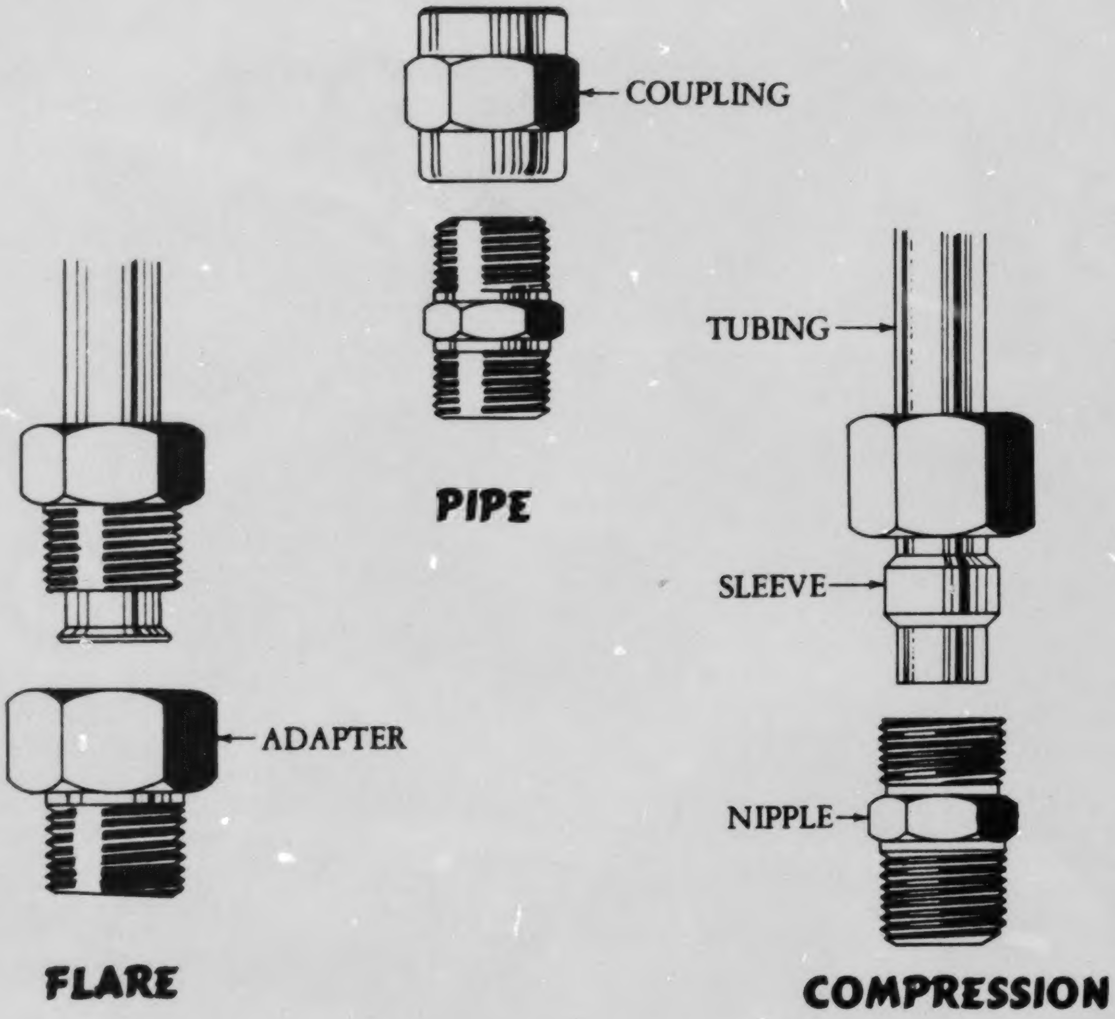
Hydraulic hose operates under pressure. However, hydraulic oil return lines may operate under low pressure hose. Usually large hoses are constructed for low pressures and small hoses for high pressures. For example, medium, high, and very high hydraulic hose pounds of pressure per square inch for two sizes are as follows:

Size (Inches)	Medium	High	Very High
3/8	2250 psi	4000	5000
2	350 psi	1125	2500

Hydraulic hose is usually reinforced with several plies of fiber and wire braid. The standard power steering and power brake hose may contain several plies of fabric with no wire (Figure 3).

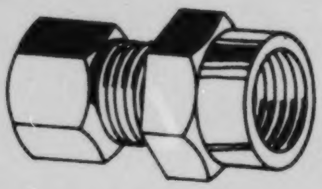
High pressure hose is equipped with either permanent or resizable fittings. Permanent fittings are crimped on the hose. This means that the fittings are discarded along with a damaged hose. If power steering and hydraulic hoses are damaged, they should be replaced with factory prepared replacements.

TUBING CONNECTIONS
THREE TYPES

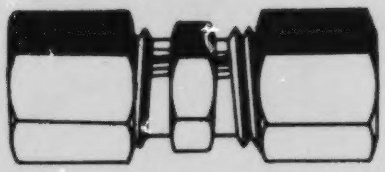

COUPLING
PIPE
TUBING
SLEEVE
ADAPTER
NIPPLE
FLARE
COMPRESSION

TUBING AND HOSE

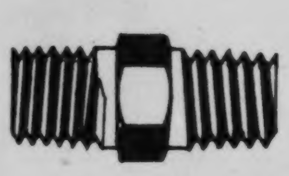
TYPICAL FITTINGS



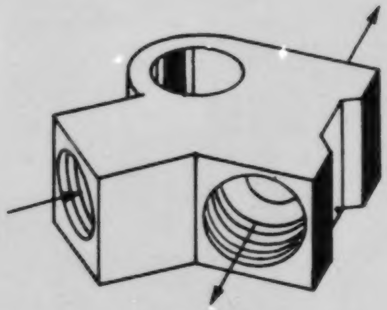
CONNECTOR



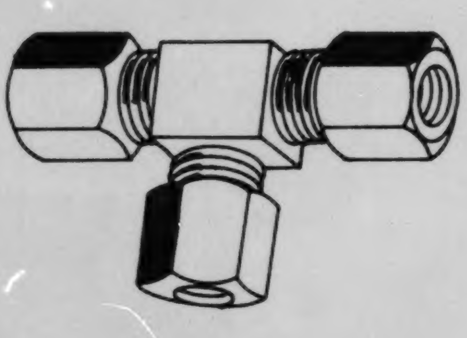
UNION



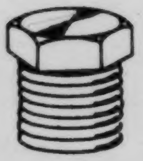
NIPPLE



DISTRIBUTION BLOCK



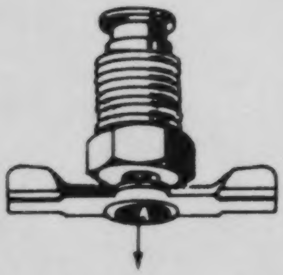
T-FITTING



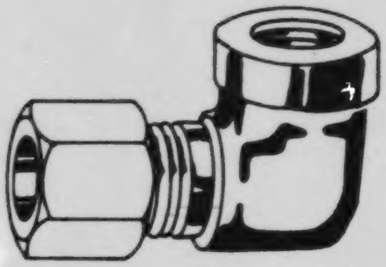
PLUG

FITTINGS AND HOSES

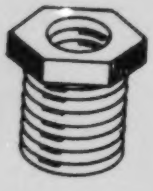
TYPICAL FITTINGS



drain valve

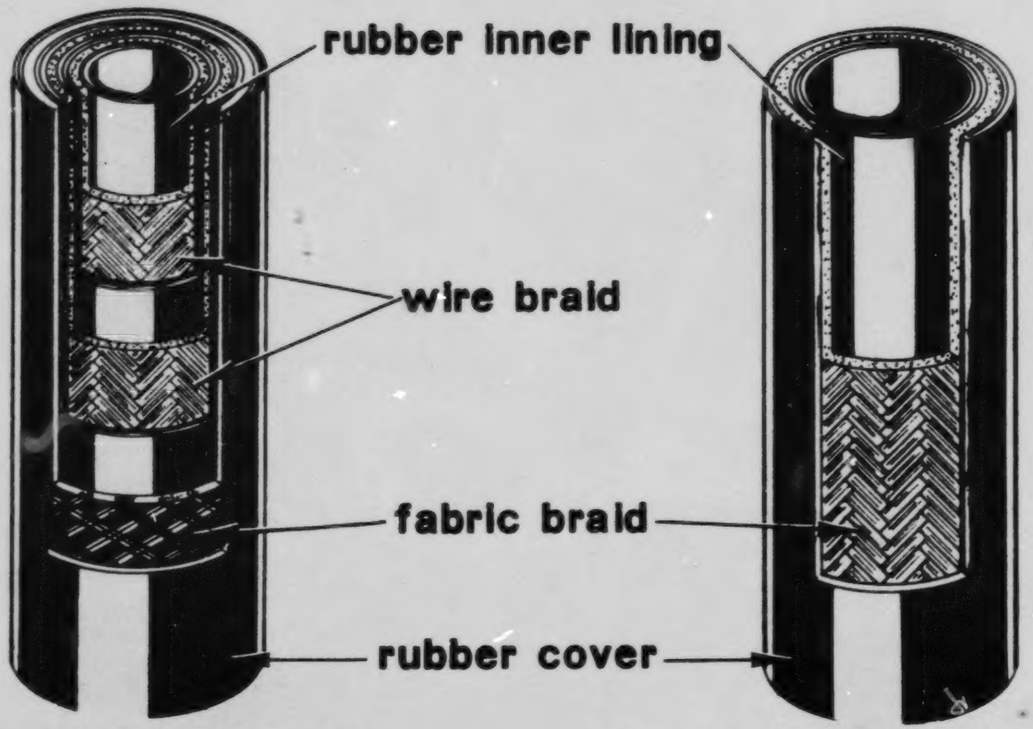


elbow



bushing

TYPES OF HOSES


rubber inner lining
wire braid
fabric braid
rubber cover

HIGH PRESSURE

LOW PRESSURE

Assignment Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Primary Soil Tillage Equipment

TOPIC: Moldboard Plows

OBJECTIVE: To develop an understanding of the moldboard plow and the factors affecting its operation.

REFERENCES:

1. Farm Machinery and Equipment, pp. 94
2. Machines for Power Farming, pp. 141-169
3. Information Sheet, "Moldboard Plows"

QUESTIONS OR ACTIVITIES:

1. List the types of moldboards that are used on moldboard plows.
2. What factors affect the draft of the plow?
3. Define "draft."
4. List the types of moldboard plows produced by agricultural machinery manufacturers for use by farmers.
5. Explain the difference between vertical line of draft and horizontal line of draft.
6. List the types of hitches available for mounted moldboard plows.
7. Plow bottoms are not sharp like a disk blade. The front of the share is a pointed wedge. If we point the share down and go ahead, perhaps the point will penetrate, provided the pointing angle is correct, the soil is not too hard, and the point is sufficiently sharp. If the share point penetrates the soil, what determines the depth to which the point will go before leveling out?
8. List the common degrees of suction used on most plows.

VOCABULARY: The following key words or terms have been used in this assignment and should now be a part of your vocabulary. Explain or define each.

Land
Landside
Furrow
Colters
Penetration

Study the drawing of the moldboard plow bottom and parts. Be able to name each part.

Information Sheet
on
MOLDBOARD PLOWS

The moldboard plow is one of the most complete tillage tools used. It lifts, cuts, and turns the furrow slice which leads to:

1. More complete crop residue and trash burial
2. Better aeration of the soil
3. Better control of weeds, insects, and crop diseases
4. Incorporation of fertilizer into the soil
5. Better seedbeds for higher germination percentages

In order to understand the operation of the moldboard plow, it is necessary that you be able to identify the machine parts and understand their functions.

Part	Function
Beam	The frame that holds the plow bottoms in the correct position
Frog	That part of the plow to which all other bottom parts are bolted
Share	That part of the plow bottom that cuts the underside of the furrow slice away from the land
Moldboard	Turns the furrow slice on edge
Landside	The long flat metal piece which absorbs the side forces created when the furrow is turned and levels the plow bottom into a free floating position
Bottom	Turns and pulverizes the soil
Colters	The round disk blade used for cutting the earth and trash ahead of the plow

Several types of moldboards are built by manufacturers of agricultural machinery. Each type has been designed to perform a specific function. These are:

1. Stubble
2. Breaker
3. General Purpose
4. High-speed

Three materials are used in the manufacture of moldboards:

1. Soft-center steel
2. Crucible steel
3. Chilled cast iron

Soft-center steel moldboards are used under most conditions because of their ability to scour. Steel plows are used most in the midwest because of their wear-resistant qualities. Chilled plows are better for sandy, gritty, and gravel soils. The share of a moldboard plow, which provides the cutting edge, is made of plain crucible steel, soft-center steel, chilled cast iron, and cast iron.

Moldboard Plows
(Information Sheet continued)

Several types of moldboard plows are produced by agricultural machinery manufacturers for use by farmers. These are:

1. Trailing
   a. Regular--one to eight bottoms
   b. Two-way--one to four bottoms
   c. Middlebreakers--one to four bottoms
2. Mounted
   a. Regular--one to five bottoms
   b. Two-way--one to two bottoms
   c. Middlebreakers--one to four bottoms
3. Semi-mounted
   a. Steerable--over five bottoms
   b. Non-steerable--one to five bottoms

The depth that a plow penetrates the soil and the width of the furrow are determined by the suction created by the share. Common degrees of suction used on most plows are:

1. Regular-suck (3/16")
2. Deep-suck (5/16")
3. Double-deep-suck (3/8")

Shares with a regular-suck are best suited for light, easy-to-penetrate soils. Shares with a deep-suck are built for soil that is dry and hard, and the double-deep-suck is used in stiff clay soils, gravel land, and other soils where penetration is difficult.

The depth that a plow penetrates the soil is determined by the landside. The plow bottoms level off when the heel of the landside contacts the furrow sole.

The factors of major concern to the mechanics in adjusting a plow to operate properly are these:

1. Proper draft
2. Proper hitching

Draft is the amount of resistance that a plow creates to the source of power. Draft should be kept as light as possible in order to conserve tractor power. Draft on a plow is caused by several factors. These include:

1. Soil condition
2. Adjustment of the plow
3. Depth and rate of plowing
4. Topography
5. The hitch to the tractor
6. Sharpness of the shares, colters, and jointers

The following table illustrates the amount of draft exerted on a plow bottom in the various types of soil:

Soil	Resistance (lbs, per square inch)
Sandy	3
Sandy loam, moist	3-4
Sandy loam, dry	4-6
Silt loam, moist	5-6
Silt loam, dry	6-7
Clay loam, moist	6-7
Clay loam, dry	7-8
Heavy clay, dry	9-10
Heavy clay, sod	10-11

The two types of drafts are vertical and horizontal.

On trailing plows the vertical line of draft is a straight line from the draft center of the plow to the tractor drawbar looking at the plow from the side. The draft center of the plow is a point near the top of the share and about two inches from the landside. It is located below the beam if one bottom is used, halfway between the beams if two bottoms are used.

Tendencies of the plow to ride out of the ground or for the rear of the plow to bob out of the ground are symptoms of improper vertical draft adjustment. These problems can be corrected by raising or lowering the plow drawbar to align with the vertical line of draft.

The horizontal draft line is a straight line from the draft center of the plow to the tractor drawbar looking down on the plow. The draft center for the plow is halfway between the draft center of the two outermost shares and halfway between the rear wheels of the tractor. Ideally the plow draft center and the tractor pull center should be in line if the plow is to function at its best.

The easiest way to make a horizontal adjustment is to make the tread of the tractor wheels fit the trailing plow. In the event that the two centers cannot be lined up, an adjustment halfway between these two points should be made. Unevenness of furrow slices and hard steering of the tractor are indications of improper horizontal draft adjustment.

Often it is necessary to adjust the clearance under the landside and between the landside and furrow wall.

Moldboard Plows
(Information Sheet continued)

Mounted plows are also classified according to the type of hitch used to attach them to the tractor. These include:

1. Single-point hitch, free-floating, rear-mounted
2. Three-point, free-floating, variable-pitch, rear-mounted
3. Hydraulically supported, three-point suspended
4. Hydraulically suspended, free-floating, three-point, variable-pitch

On the single-point hitch, free-floating, rear-mounted plow, the plow beam extends to a point ahead of the tractor rear axle. The height of the hitch point is adjusted manually or hydraulically. The weight of the plow causes the plow bottom to enter the ground as it is lowered into the ground. As the plow moves forward, the suction created by the share and weight of the soil being moved causes the plow to penetrate the soil until the heel of the landside comes into contact with the furrow. The depth of penetration is determined and regulated by the height of the hitch point.

The three-point, free-floating, variable-pitch, rear-mounted plow uses three links for connection to the tractor. The upper link adjusts the plow for deep or shallow plowing. The other two links are non-adjustable. The plow enters and penetrates the soil in the same manner as the single-point hitch-type plow.

The hydraulically supported three-point suspended plow is supported during plowing and moved by hydraulically-controlled linkage. This linkage holds the plow up, but does not force it into the soil. When soil resistance increases, the upper attaching link pushes against a spring controlling a hydraulic mechanism that raises the plow. The increase in weight on the rear tractor tires caused by the rising of the plow increases the traction on the tractor wheels.

The landside does not function as far as downward forces go, but it does absorb the side thrusts of the plow.

The hydraulically suspended, free-floating, three-point, variable-pitch plow combines the features of the other three plows. The plow bottoms enter the soil and come to the correct depth after the landside makes contact with the furrow sole. From this point, the plow is free-floating. The depth of penetration of the bottom is controlled by adjusting a crank which points the bottoms up or down.

While the moldboard plow is an excellent device from the standpoint of soil pulverization, trash coverage, and soil aeration, it has its disadvantages. The major one is that it is expensive to operate. Due to the design of this plow it takes a tremendous amount of power to pull it properly. This fact has recently caused some farmers to seek other means of seedbed preparation. However, due to the increased cost of additional chemicals to control weeds, insects, and disease when using other tillage tools, the moldboard remains the most consistently reliable tillage tool for row crop seedbed preparation.

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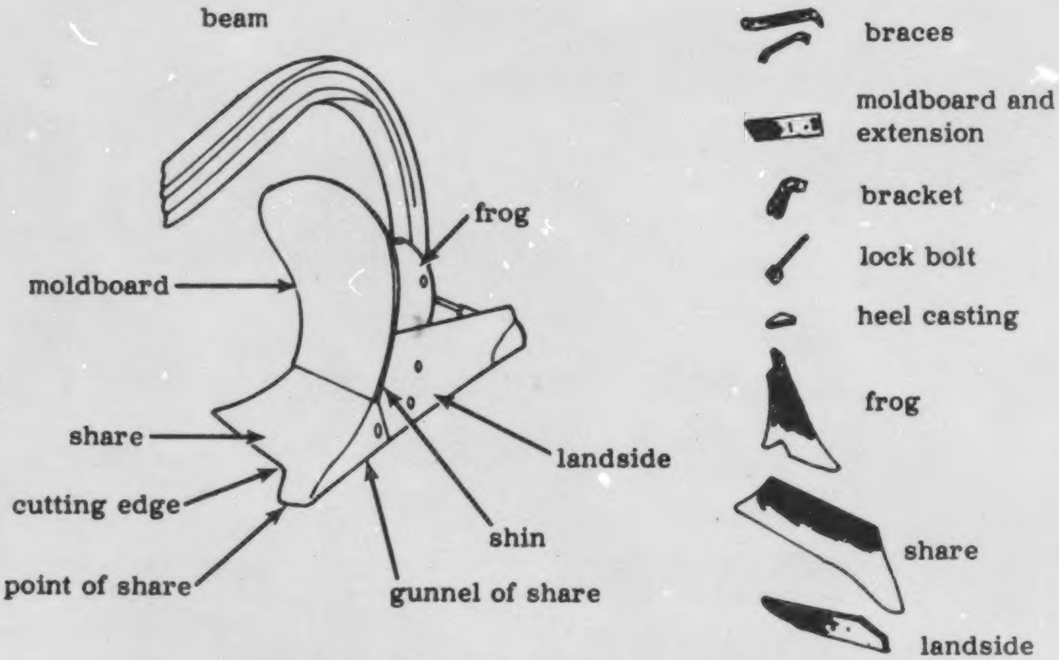
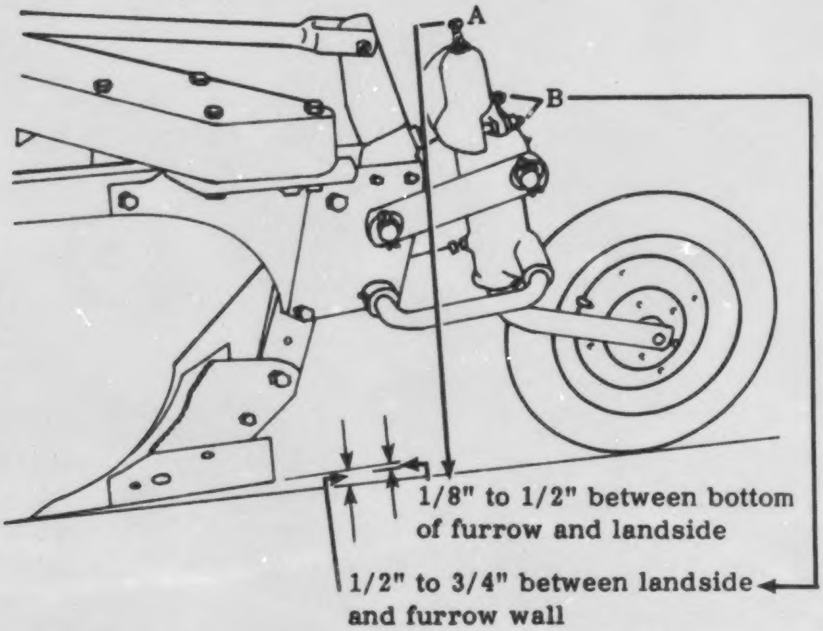
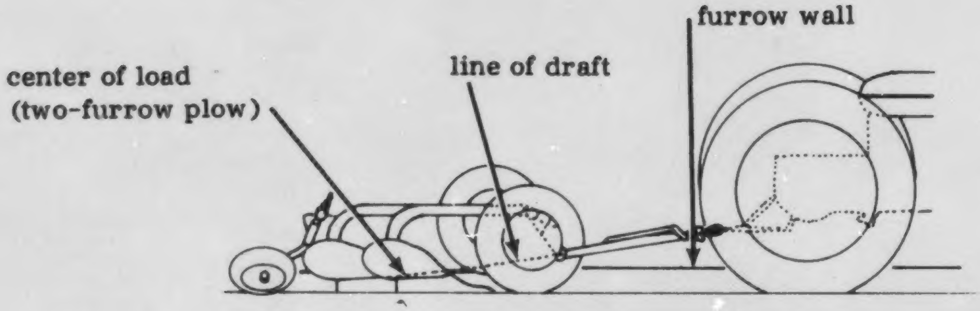
Material for this Information Sheet was taken from "Adjustment, Maintenance, and Repair of Tillage, Planting, Spraying, and Fertilizing Machinery," The Center for Research and Leadership Development in Vocational and Technical Education, The Ohio State University, Columbus, OH.


beam
frog
moldboard
share
cutting edge
point of share
gunnel of share
shin
landside
braces
moldboard and extension
bracket
lock bolt
heel casting
frog
share
landside

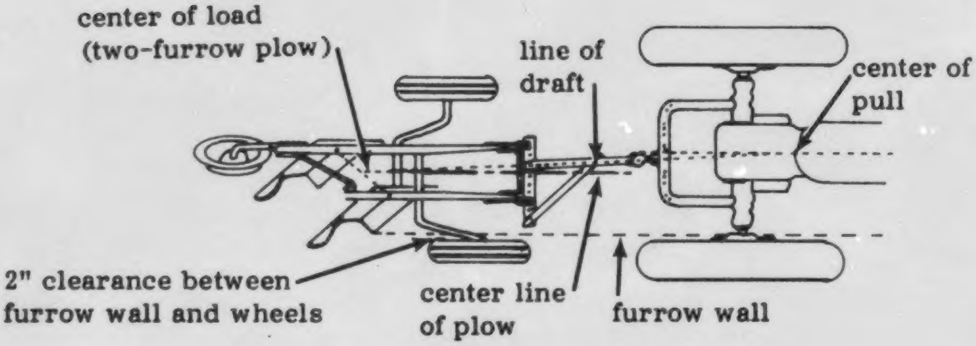
MOLDBOARD PLOW BOTTOM AND PARTS


A
B
1/8" to 1/2" between bottom of furrow and landside
1/2" to 3/4" between landside and furrow wall

RANGE OF ADJUSTMENT FOR SUCTION ON A TRAILING MOLDBOARD PLOW


furrow wall
line of draft
center of load
(two-furrow plow)

VERTICAL LINE OF DRAFT


center of load
(two-furrow plow)
line of
draft
center of
pull
2" clearance between
furrow wall and wheels
center line
of plow
furrow wall

HORIZONTAL LINE OF DRAFT

Assignment Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Primary Soil Tillage Equipment

TOPIC: Disk Plows

OBJECTIVE: To learn how to identify the parts and functions of the disk plow and to learn the types of disk plows and their specific adjustment.

REFERENCES:

1. Machines for Power Farming, pp. 176-190
2. Farm Machinery and Equipment, pp. 116-125
3. Information Sheet, "Disk Plows"

QUESTIONS OR ACTIVITIES:

1. What are the common types of disk plows?
2. List the conditions under which a disk plow would be preferred over a moldboard plow.
3. Compare the draft of a disk plow to that of a moldboard plow.
4. Explain what 26" x 3/16" means, with reference to a disk plow.
5. Name the three types of wheels on a disk plow and give the function of each.
6. List the three types of adjustments that are common to disk plows and give the steps involved in each.

VOCABULARY: The following key words or terms have been used in this assignment and should now be a part of your vocabulary. Explain or define each:

Concavity
Standard
Scrapers
Tilt or slant

Information Sheet
on
DISK PLOWS

The disk plow has one or more rolling cutters. It creates no suction, as a moldboard plow does, and depends on weight and disk angle for penetration. Its maintenance cost is low, and its parts last a long time.

The disk plow works well under the following adverse conditions:

1. Wet, sticky, non-scouring gumbo, hardpan, or black waxy soil
2. Soils containing large stones or rocks
3. Dry, hard soil
4. Rooty, stumpy soil
5. Abrasive soils

The three main types of disk plows are:

1. Direct-mounted
2. Semi-mounted
3. Trailing

Direct-mounted plows are attached to the tractor by one-, two-, or three-point hitch linkages and can be raised or lowered hydraulically. They usually are rear-mounted and have a rear wheel to absorb the side thrust.

Semi-mounted disk plows are attached to the tractor drawbar or to a special drawbar. They are raised by moving a lever at the front of the plow. A long rod which extends to the tractor drawbar is used to steer the rear wheel.

Trailing disk plows have three wheels for support and can be pulled by any make of tractor. The front wheel performs the following functions:

1. Helps lift the plow
2. Turns sideways for steering the plow
3. Absorbs some of the side thrusts

The rear wheel is non-steering, but it absorbs thrusts and lifts the rear part of the plow.

The draft created by a disk plow is usually about the same as that of the moldboard plow, but since the disk plow is often heavier than the moldboard plow, its draft is usually greater.

The increase in draft is usually about ten percent. Because of this high power requirement, time spent assuring top tractor performance can reduce fuel cost, save time, and result in better all around operation.

Disk Plows
(Information Sheet continued)

The disk plow is comprised of the following parts:

1. Disk blades
2. Standards and clamps
3. Bearings
4. Beams and frames
5. Lifting and steering mechanisms
6. Wheels

The disk bottom is a perfectly round concave disk of heat treated steel, sharpened on the edge for easier penetration. The size of these disks ranges from 20-38 inches with an average thickness of 3/16 inch for the smaller sizes and 3/8 inch for the larger.

Three types of adjustments are common to all types of disk plows. They are:

1. Cutting angle adjustment
2. Width-of-cut adjustment
3. Vertical adjustment of the disk blade

Disk blades will not cut if they roll straight ahead, but must work at an angle. This angle is measured between a perpendicular line from the line of travel to the axle line of each disk blade. The cutting angle of the disk plow can be changed by either of two methods:

1. Pivoting the beam
2. Pivoting the blade and standard
   (See Machines for Power Farming, pp. 182-183)

Two adjustments can be made to adjust the width-of-cut made by the plow.

1. Front disk blade cut adjustment
2. Cutting width adjustment
   (See Machines for Power Farming, pp. 184-185)

The vertical adjustment or position of the disk blade, also called the tilt or slant, directly affects the degree of penetration of the plow in relation to the amount the disk is inclined from the vertical position. Two methods can be used in tilting the disk:

1. Standard-to-beam method
2. Standard-to-bearing method
   (See Machines for Power Farming, p. 186)

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Material for this Information Sheet was taken from "Adjustment, Maintenance, and Repair of Tillage, Planting, Spraying, and Fertilizing Machinery."

Assignment Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Primary Soil Tillage Equipment

TOPIC: Middlebusters and Listers

OBJECTIVE: To develop an understanding of the parts of middlebusters and listers and their functions and to be able to recognize the difference between middlebusters and listers.

REFERENCES:

1. Farm Machinery and Equipment, pp. 103-106
2. Machines for Power Farming, pp. 170-175
3. Information sheet, "Listers and Middle Busters"

QUESTIONS OR ACTIVITIES:

1. How does the lister bottom differ from the middlebuster bottom?
2. List the types of middlebusters and listers.
3. How are middlebusters and listers classified?
4. Name the principal parts of a middlebuster and lister.
5. Define the following terms:
   a. Flatbreaking
   b. Middlebreaking
   c. Busting
   d. Ridge sweeping
   e. Hipping
6. Explain the difference between front mounted and rear mounted middlebusters.

Information Sheet
on
LISTERS AND MIDDLEBUSTERS

Lister, bedder, middlebuster, and middlebreaker are all common names for equipment that is basically the same. They usually consist of a double moldboard plow or can even be made of disks. At any rate their main function is to prepare land for planting. They can be used as either a primary or secondary tillage tool.

The main difference between a lister and a middlebuster is that the lister bottoms are suitable for general purpose plowing while the middlebuster bottom is used in areas requiring a blackland type of moldboard.

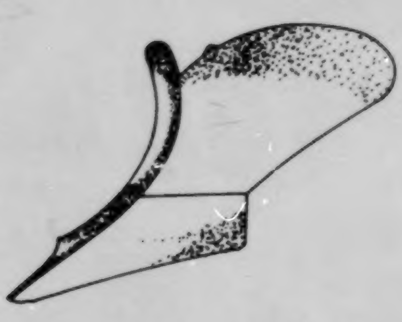
There are several different types of listers and middlebusters. The type that should be used in a particular case depends on the soil type and the desired results. Various bottoms have been developed to meet the conditions presented by various soils. Some of these are:

1. General purpose - developed for fairly high speeds in light land.
2. Hard ground - designed for use in exceptionally dry or hard packed soil.
3. Black land - developed with fairly small moldboards for better scouring in heavy soils.
4. Disk bedder - Disks designed for heavy soils. These have 2 or 3 blades per gang depending on the desired results.

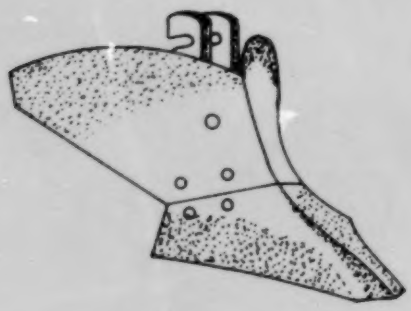
Listers and middlebusters are normally classified by the number of bottoms. These can be mounted either behind or just ahead of the rear wheels. The forward mounting gives excellent visibility of the work but they take more time and effort to mount. Rear mounted listers are becoming much more popular due to the ease of attachment. Another benefit of this type is the wide variation available in the row spacing.

When using a lister or middlebuster the land can be worked in several different ways. Which is best depends on the soil type, climate conditions, and the crop that is to be planted. Some of these methods are:

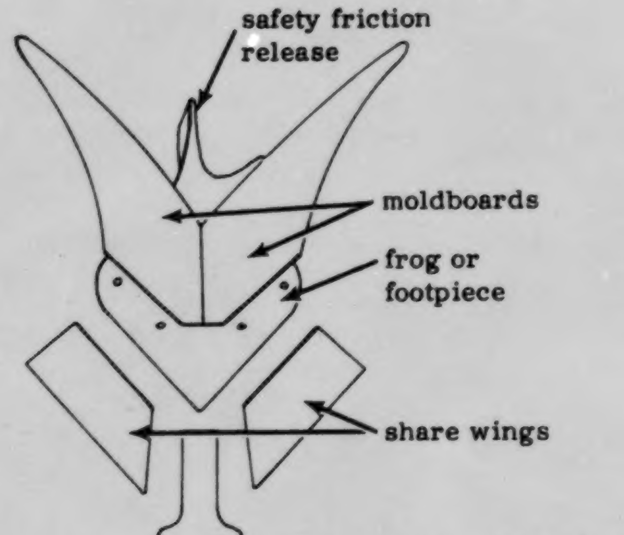
1. Flat breaking - turning the land over so that the finished job appears flat.
2. Middlebreaking - plowing so that the land is left in ridges and furrows.
3. Busting - another name for middlebreaking.
4. Ridge sweeping - preparing the top of a ridge for planting.
5. Hipping - cleaning of furrows and reshaping of beds using a lister or bedder.



LISTER BOTTOM WITH
HIGH MOLDBOARDS

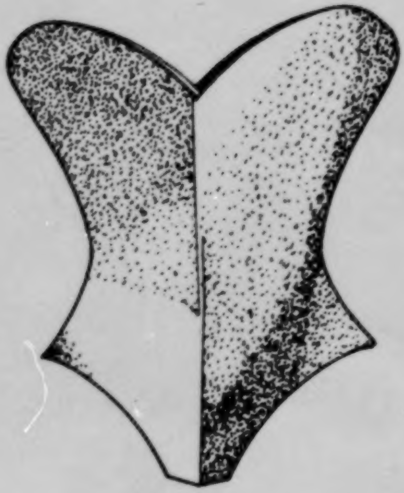


MIDDLEBUSTER BOTTOM

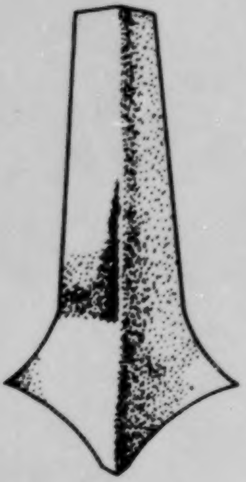

safety friction release
moldboards
frog or footpiece
share wings
replaceable point

PARTS OF A LISTER BOTTOM

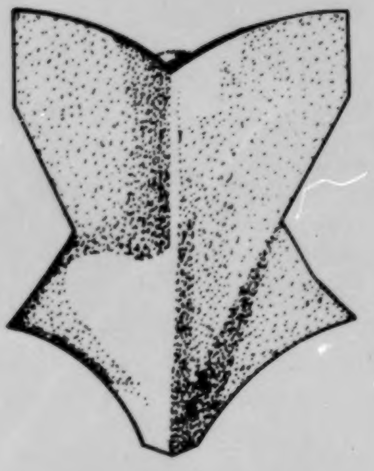
TYPES OF BEDDERS



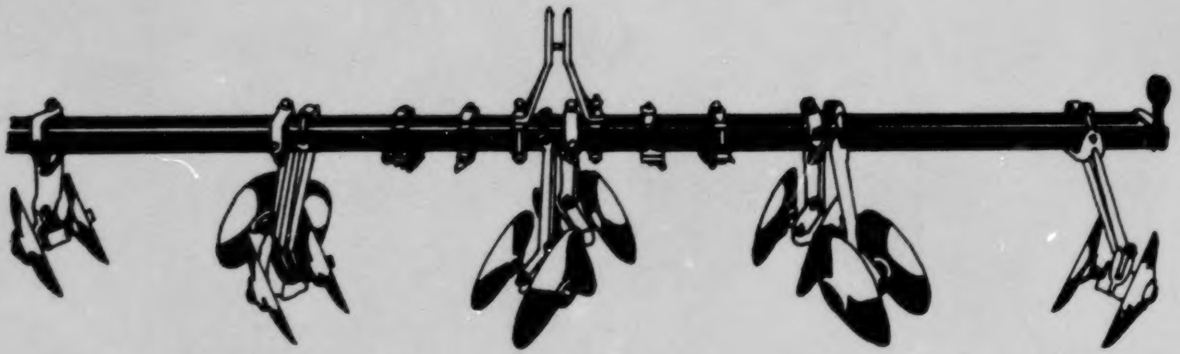
GENERAL-PURPOSE



HARD-GROUND



BLACKLAND



DISK

Assignment Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Primary Soil Tillage Equipment

TOPIC: Rotary Plows

OBJECTIVE: To develop an understanding of the types and functions of rotary plows.

REFERENCES:

1. Farm Machinery and Equipment, p. 125
2. Information Sheet, "Rotary Plows"

QUESTIONS OR ACTIVITIES:

1. When was the rotary plow invented?
2. Why has the American farmer only recently become interested in the rotary plow?
3. List the four types of rotary plows.
4. How is the pull auxiliary-engine rotary plow pulled and how are the knives driven?
5. Give the sizes available and the horsepower required for a pull auxiliary-engine rotary plow.
6. At what r.p.m. does the tractor-mounted power take-off-driven rotary plow operate?
7. How wide a strip will the self-propelled garden-type rotary plow make?
8. What is negative draft?
9. What are the energy requirements for a rotary tiller as compared to a moldboard plow?
10. List 5 jobs that rotary tillers can perform.

Information Sheet
on
ROTARY PLOWS

The rotary plow was developed in the 1870's and has been used widely in Europe for many years. The main reason it did not become popular in the United States was the high power requirements and the high initial cost. Recently, however, it has become more popular due to its reduced draft and the idea of "once over" seedbed preparation. By using this type of plow where power is applied to the soil through the PTO rather than tractive force, less power is lost and compaction is reduced.

There are four basic types of rotary plows or, as they are sometimes called, rotary tillers. These are:

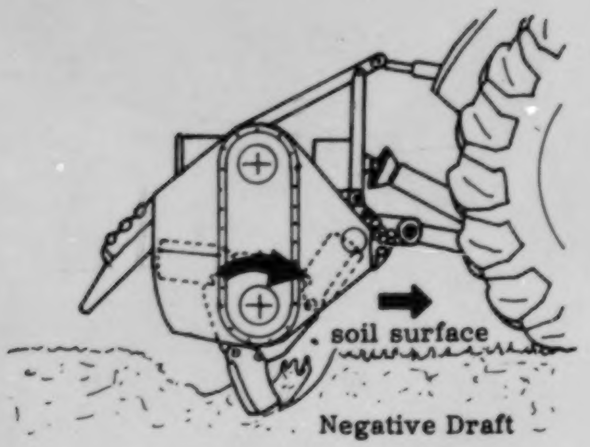
1. Self propelled - these are heavy duty models that are normally used in construction. These are seldom used in agriculture.
2. Tractor drawn with auxiliary engine - this type is pulled forward by the tractor while the cutting blades are driven by the auxiliary engine. This type comes in varied widths and takes between 60-90 horsepower to operate.
3. Tractor mounted-PTO driven - this is probably the most popular due to its versatility. These also vary in widths and require about 15 horsepower to operate per foot of width.
4. Self propelled garden tillers - these models are usually walked behind and plow a strip from 9 to 30 inches and require between 6 and 15 horsepower to operate.

One major advantage of rotary plows is that they actually provide negative draft, meaning that the rotating blades tend to propel the tractor forward. Even with the fact of negative draft the energy requirements for these machines are exceptionally high. In fact it may be as much as three times that of moldboard plowing. Energy used may even exceed that used in plowing, disking, and harrowing.

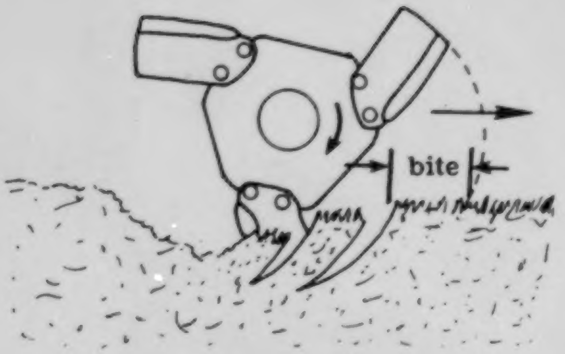
As these implements become more popular new uses are being made of them. Some of these are:

1. Shred and mix stalks with the soil
2. Replace plow disk and harrow
3. Cultivate row crops
4. Renovate pastures
5. Reclaim wasteland
6. Till orchards and vineyards
7. Landscape
8. Strip tillage

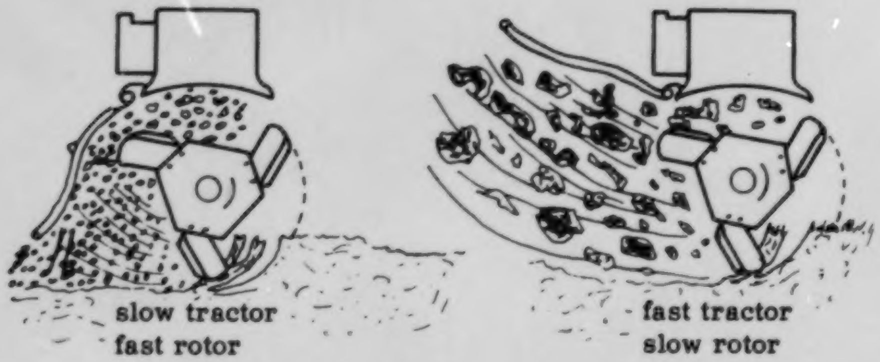
Another advantage to the soil is that the tilth may easily be controlled. If a fine tilth is desired, a fast rotor, slow tractor speed is combined with a closed shield. To produce a coarse tilth, use a slow rotor, fast tractor speed, and an open shield.


soil surface
Negative Draft

BLADES PUSH THE TRACTOR FORWARD



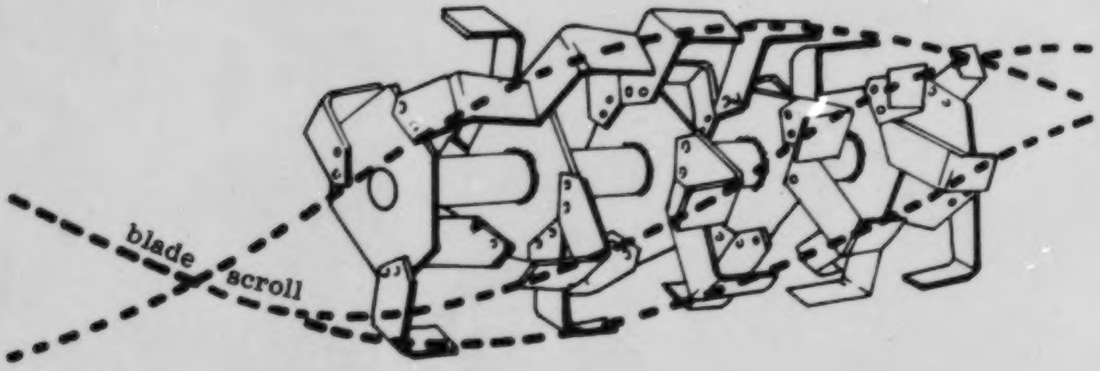
BLADE BITE IS DETERMINED BY SPEED


slow tractor
fast rotor
fast tractor
slow rotor

Fine Tilth

Coarse Tilth

DESIRED TILTH IS PROVIDED BY ADJUSTING SOIL SHIELD AND SPEED


blade
scroll

BLADES IN A SCROLL PATTERN PROVIDE SMOOTH OPERATION

Assignment Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Primary Soil Tillage Equipment

TOPIC: Chisel Plows and Subsoilers

OBJECTIVE: To develop an understanding of the types and functions of chisel plows and subsoilers.

REFERENCES:

1. Machines for Power Farming, pp. 203-206
2. Farm Machinery and Equipment, pp. 127-129
3. Information Sheet, "Chisel Plows and Subsoilers"

QUESTIONS OR ACTIVITIES:

1. Describe the difference between a chisel plow and a subsoiler.
2. Compare the size of tractor needed for a chisel plow with one needed for a subsoiler.
3. Name the three layers of earth or soil.
4. List the two types of subsoilers.
5. List the types of points available for a chisel plow.
6. List the parts of a subsoiler.
7. What is the range on the width of the furrow of a chisel plow?
8. What are the size ranges of chisel plows?

Information Sheet
on
CHISEL PLOWS AND SUBSOILERS

The basic action of a chisel plow and a subsoiler are the same. They break up and aerate the soil without inversion. The main difference between the two is the depth at which they operate. The chisel can be operated at depths up to about 18 inches depending on its design, soil conditions, and soil engaging tool used. The subsoiler normally runs from 18 to 36 inches and usually has a fairly limited selection of bottoms.

First, a look at the chisel. As was stated, the chisel does not invert and crush the soil as does the moldboard. It merely breaks and stirs the soil in place. Therefore, these plows have their greatest effect when used in hard dry soils, especially if a hardpan has developed. The chisel does not completely cover the trash; therefore, it is often used for stubble-mulch tillage.

Draft of chisels is approximately half that of a moldboard when worked at the same depth. Therefore, chiseling is faster and more economical. The speed that the plow is pulled depends upon the soil type, desired results, and the power of the tractor used. The faster a chisel is pulled the more disturbance of the soil there will be.

Another method of varying soil disturbance is by selection of the proper bottom to fit the shank. Some of the types are described below with an illustration of each on following pages.

A. Regular Wheatland Sweep - kills weeds with minimum ridging
B. High Crown Sweep - lifts and stirs soil
C. Heavy Duty Low Crown - kills weeds with less soil stirring
D. Chisel Sweeps - better water absorption, less wind erosion
E. Heavy Duty Regular Sweep - maximum strength, moderate soil stirring
F. Furrow Opener - leaves soil grooved for minimum erosion
G. Beavertail Sweep - used in excessively dry conditions
H. (H&I) Reversible Chisel Point - kills weeds and grooves the soil
J. Double Point Chisels - used in abrasive soils
K. Spike - kills weeds and removes plowpan
L. Reversible Double Point Shovel - kills weeds and grooves soil
M. Twisted Shovel - works somewhat like a moldboard

Chisels may either be of the drag type or may be an integral three-point hitch. The small widths (5 ft - 10 ft) will usually be integral mounted with the larger (up to 45 feet) being drag type.

Chisel Plows
(Information Sheet continued)

When operating a chisel, the furrow widths may be as narrow as 12 inches or as wide as three feet, depending on the discretion of the operator.

The subsoiler has the same general method of operation as the chisel, except it is operated at a much greater depth. In most soils there are three layers concerning the farmer. These are topsoil, hardpan, and the subsoil. Where chisels usually work the topsoil and part of the hardpan, subsoilers work all three layers.

There is some controversy as to the benefits of using a subsoiler, but, when used properly in the right type of soil it will improve water infiltration, drainage, and root penetration. In order for it to be effective, it must be used when the soil is relatively dry and hard. This leads to a lifting and slight crushing of the soil. It also works best in heavy clayey types of soils.

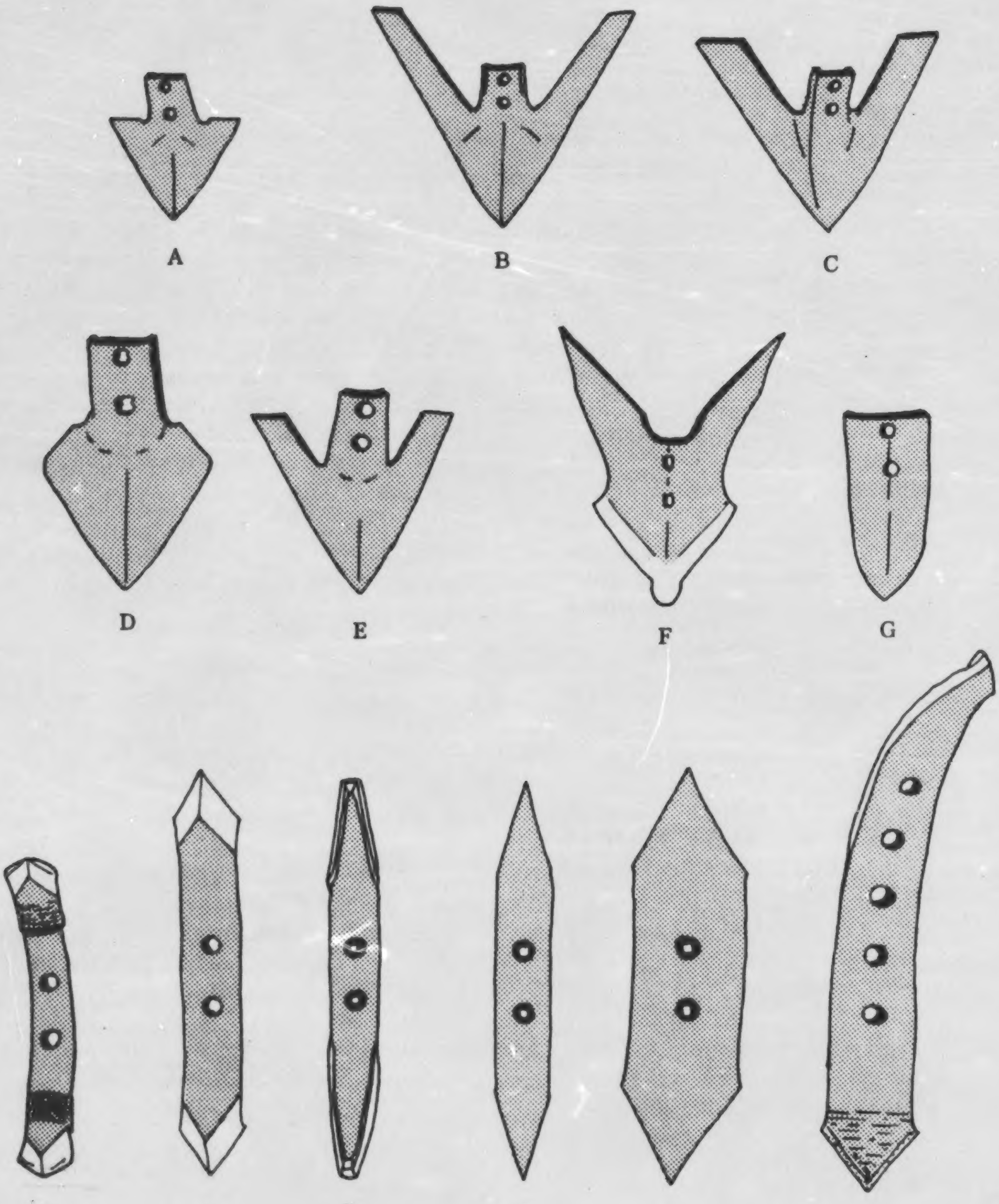
There are two types of subsoilers, the integral mounted type and the pull type. The mounted type is the most popular because of its versatility, lower initial cost, and the increased tractor size.

A subsoiler consists of relatively few parts; a toolbar, a standard, a point, sometimes a reversible shin, wheels and axle, and a few minor attachments. The design of the standard greatly affects the draft of the plow. A vertical shaft will require about 25 percent more power to pull than a curved or slanted one.

The points and shins are usually replaceable or reversible.

Another attachment sometimes used with a subsoiler is the mole ball. This is an oval shaped device that when pulled behind the subsoiler leaves a tunnel which can be used to drain problem areas. Care must be taken when using this device in order that not too steep a slope is used; otherwise, excessive erosion may occur.

Tractor size used to pull chisels and subsoilers varies with the plow and soil, but as a rule it ranges from 5 to 75 horsepower for a chisel and from 25 to 100 horsepower for a subsoiler.


A
B
C
D
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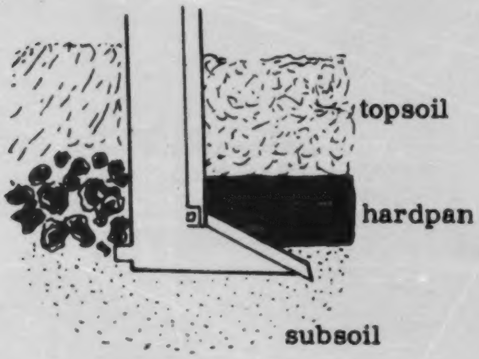
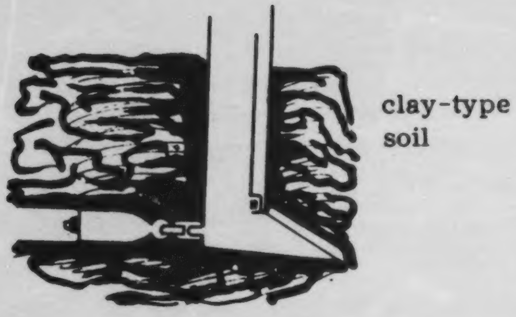
L
M

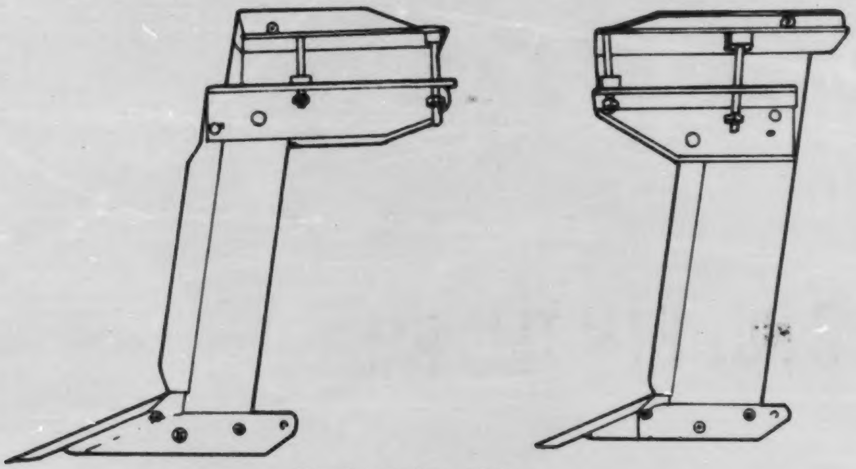
VARIOUS CHISEL-PLOW SOIL-ENGAGING TOOLS


topsoil
hardpan
subsoil

THREE SOIL LAYERS

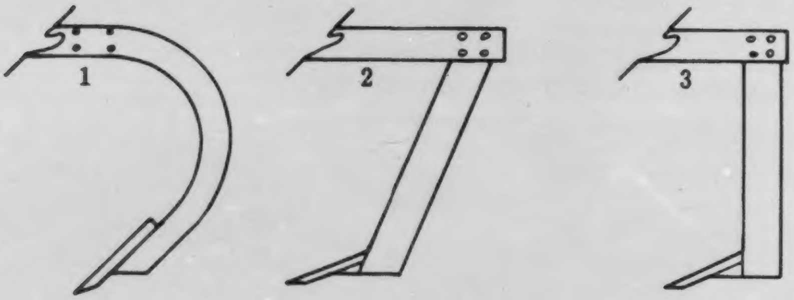

clay-type
soil

SUBSOILER AND MOLE ATTACHMENT



Replaceable Shins

TAPERED SHINS FOR REDUCED DRAFT



1 and 2 require about 25% less pull than 3

THREE TYPES OF SUBSOILING STANDARDS

Assignment Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Secondary Tillage Equipment

TOPIC: Disk Harrows

OBJECTIVE: To develop an understanding of the types and functions of disk harrows and to become familiar with the specific adjustments and operation.

REFERENCES:

1. Machines for Power Farming, pp. 209-223
2. Farm Machinery and Equipment, pp. 145-154
3. Information Sheet, "Disk Harrows"

QUESTIONS OR ACTIVITIES:

1. Give the purpose of the disk harrow.
2. Name the two main types of disk harrows.
3. List the various ways of determining the size of a disk harrow.
4. What are the two main types of harrow disks?
5. Describe and give the functions of the two types of harrow disks.
6. List ways which can be used to control the depth to which the disk blade penetrates.
7. What are the basic parts of a disk harrow?
8. List and explain the methods of angling a disk harrow.

VOCABULARY: The following key words or terms have been used in this assignment and should now be a part of your vocabulary. Explain or define each:

Gang
Tandem
Angling
Bush and log harrows

Information Sheet
on
DISK HARROWS

The disk harrow is one of the most popular tools used on American farms today. Due to its wide adaptability and versatility it can be used to accomplish a wide range of jobs.

The disk harrow breaks up clods by means of a steel disk. It mixes the soil thoroughly, bringing together vital plant food elements. It levels the land, aerates the soil, kills weeds, and prepares the land for seeding.

Disk harrows have been used in this country since the late 1860's. Since then, their early basic design has been altered to meet the needs of varying conditions. Early disk harrows were of the single action type. This means that they had one set or pair of gangs and only threw the dirt outward. Later the double or tandem disk was developed with the trailing gangs throwing the dirt inward. Another type of disk that was developed is the offset, which is made up of only two gangs working in line and moving the soil in opposite directions.

When determining the size of a disk, there are several factors to be considered. First is the width of cut when the gangs are fully angled. This width varies greatly and usually depends on the size of tractor being used, size of field, and time available to complete the operation. Sizes start at about 5 feet and go up to larger plows to accommodate larger tractors. As new larger tractors are introduced, a new disk is usually built to go with it, or two or more smaller disks may be hooked together to attain maximum width.

Another method of sizing a disk is by the diameter of the blades. Sizes vary with the requirements for the operation but generally range between 16 and 32 inches. The smaller blades have better penetration qualities, but the larger are better when plowing in heavy trash.

The number of blades per gang is another important consideration. The more blades per gang the smoother the final operation will be. Some have as few as eight, while others may have 30 or more.

The final way disk harrows are sized is blade spacing. Ideal spacing depends on the desired results and varies from 7 to 14 inches. Proper selection must include consideration of soil and trash conditions, size of blades, working depth, and intended use. Some general guidelines are:

7 inch - used in plowed soil, little trash or extremely hard soil.
9 inch - used for general disking with moderate trash.
11 inch - deep disking in heavy trash.
13 inch - extra deep work, extreme soil and trash conditions (primary tillage).

Disk Harrows
(Information Sheet continued)

Another consideration is the type of blades to be used. Here again the type used depends on the desired results. There are two types of edges found on disks, smooth and notched or scalloped. The notched disk is better at cutting trash but is usually more expensive. Therefore, notched disks are usually placed on the front gangs and smooth on the trailing. The plain smooth edged disks usually have about two inches of concavity per 20 inches of diameter. These disks also come with a concave center or a flat crimped center. The flat center is stronger and will normally last longer.

Disks are either the spherical type or the conical or cone shaped type. Cone shaped disks are usually more aggressive but may plug easier in heavy, sticky soils.

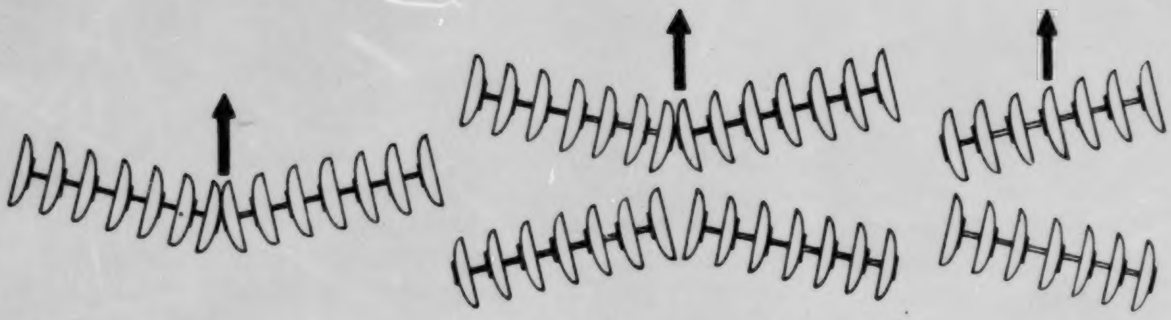
Disk penetration can be controlled in many ways. Some of these are:
A. Using a heavy or lighter harrow
B. Adding weights
C. Varying the number of disks per gang
D. Exerting hydraulic forces up or down
E. Using depth regulating wheels
F. The sharpness of the disks
G. Size of the blades
H. Type of blades
I. Angle of gangs

The disk harrow has a number of component parts. These vary depending on the type, but some of the more common parts are:

1. disks
2. disk gangs
3. frame
4. standards
5. bearings
6. bumpers
7. scrapers
8. weight boxes
9. leveling devices

There are several methods of angling harrows. Two of these are:
Drive ahead to straighten - This is done with a slider on the drawbar tongue.
Back up to straighten - This is accomplished with the inner ends of the gang which are fastened to the slider.

As longer disks come into use, it has become more popular to use flexible wings to accommodate the contours of the field.
Some blade breakage must be expected when working under severe conditions. This can be kept to a minimum with careful operation and careful equipment selection. Some broken blades and their causes are illustrated.

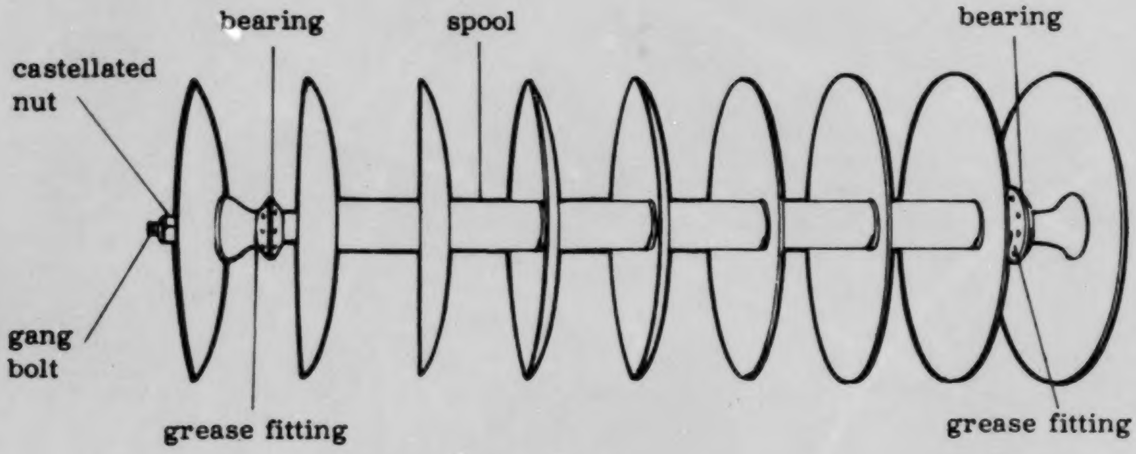


Single-action

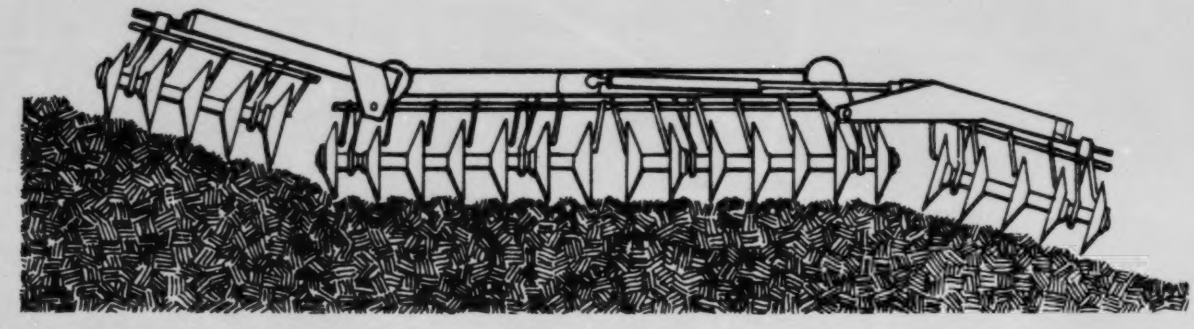
Double-action or tandem

Offset

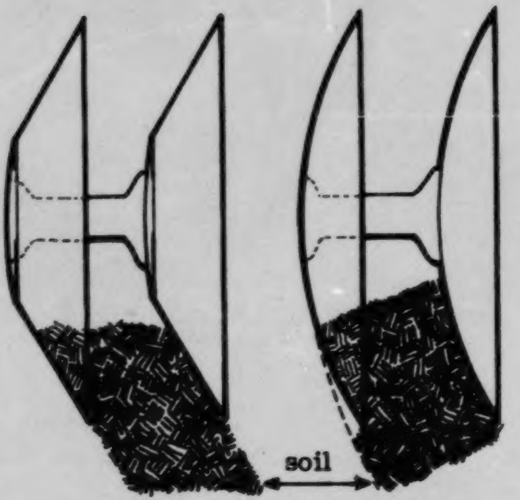
TYPES OF DISK HARROWS ACCORDING TO GANG ARRANGEMENT


bearing
spool
bearing
castellated nut
gang bolt
grease fitting
grease fitting

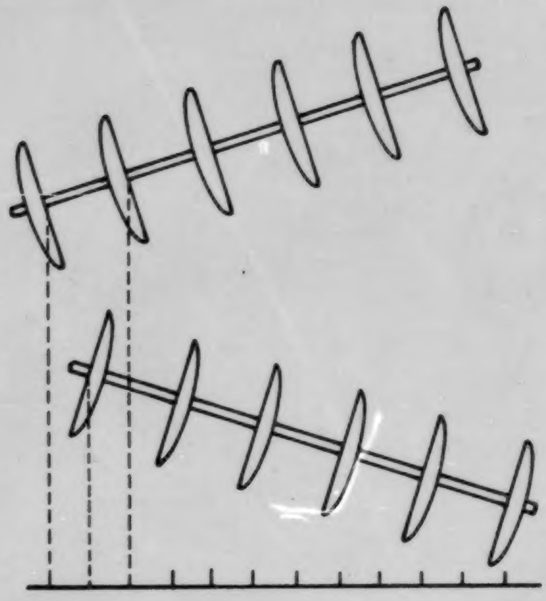
A TYPICAL DISK GANG



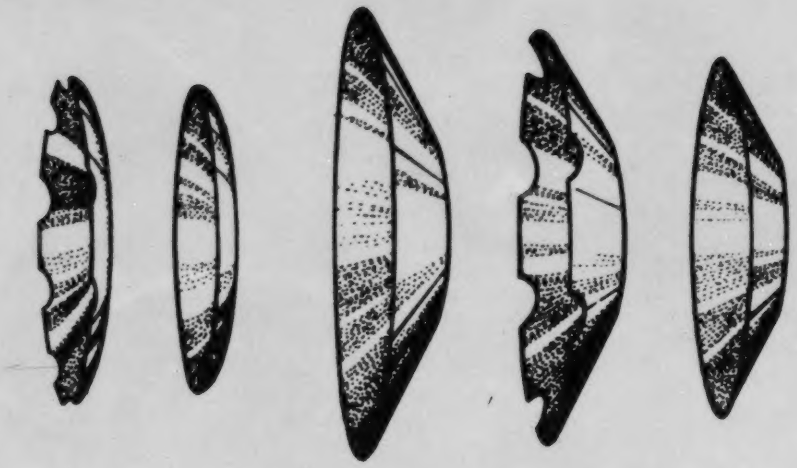
FLEXIBLE WINGS FOLLOW GROUND CONTOURS



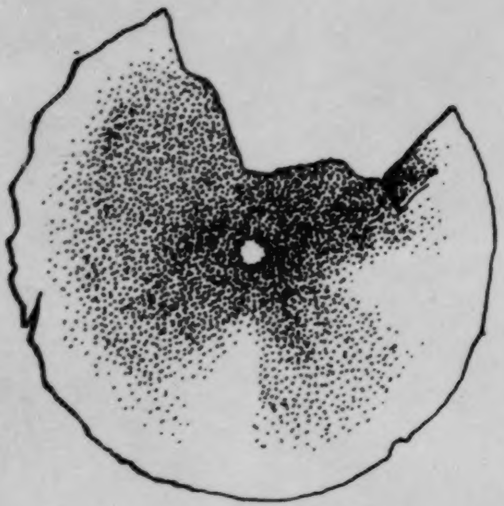
CONE BLADES SPHERICAL BLADES



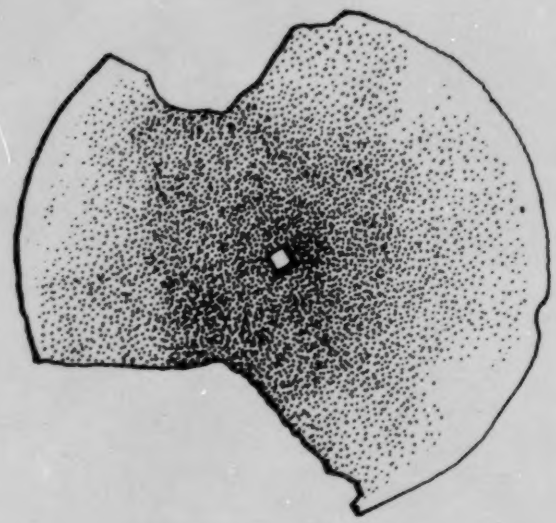
REAR BLADES CUT HALF WAY BETWEEN FRONT BLADES



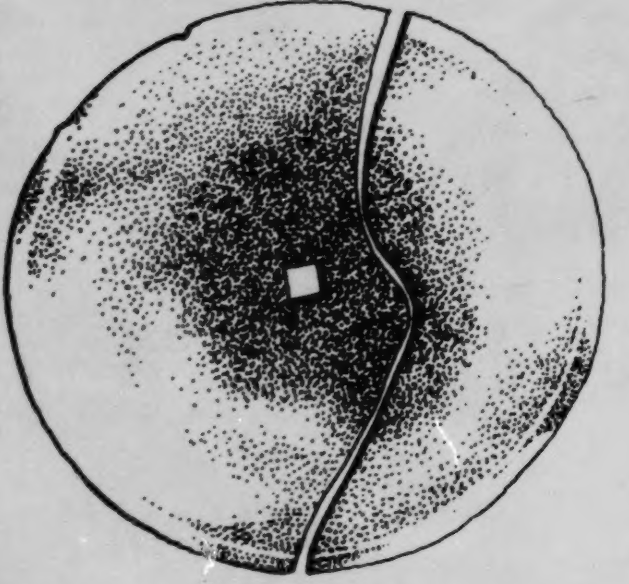
BLADE SIZES VARY



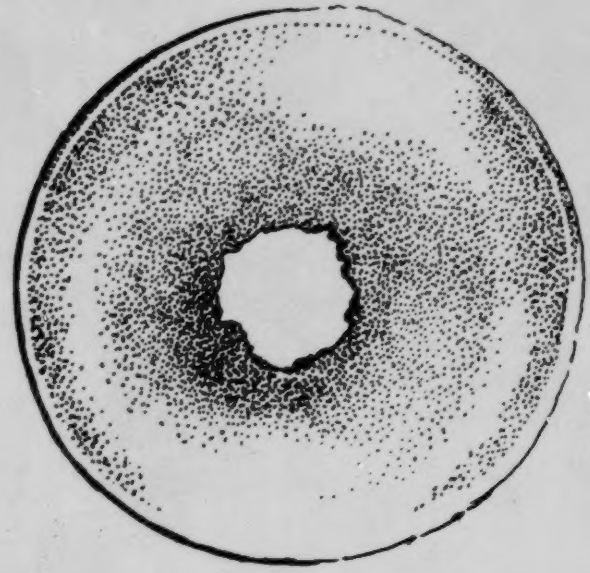
DAMAGE FROM SOIL OBSTRUCTIONS



SEVERE STONE OR SLUMP DAMAGE



BREAKS FROM STONES OR STUMPS



TORN CENTER - LOOSE GANG BOLT

Assignment Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Secondary Tillage Equipment

TOPIC: Spring-Tooth Harrows

OBJECTIVE: To develop an understanding of the types and functions of spring-tooth harrows and to become familiar with the specific adjustments.

REFERENCES:

1. Machines for Power Farming, pp. 224-231
2. Farm Machinery and Equipment, pp. 154-156
3. Information Sheet, "Spring-Tooth Harrows"

QUESTIONS OR ACTIVITIES:

1. What is the purpose of a spring-tooth harrow?
2. List the two main types of spring-tooth harrows.
3. Name four types of spring-teeth according to their use.
4. List the major parts of a spring-tooth harrow.
5. List the steps one should follow in adjusting a spring-tooth harrow.

Information Sheet
on
SPRING-TOOTH HARROWS

The spring-tooth harrow is used to make final preparations for seeding. It works well in rough or stony soils where the spring teeth can move over or around obstacles. It is often used where soils have crusted over or to remove grass and weeds by pulling them out rather than cutting them. It normally works from 3 to 6 inches deep.

There are two types of spring-tooth harrows, the lift type and the trailing type. The lift type is the most maneuverable and works the best in trashy conditions. It is attached to the three point hitch and can be lifted over grassways and roadways. These may have as many as three sections, each being up to nine feet wide. These sections work somewhat independently to compensate for the contour of the field. Depth is controlled by the hydraulic system of the tractor.

Trailing harrows use runners or wheels to lift them clear of the ground for transport. The runners also control the working depth.

The size of the harrow depends on the power available, the desired depth, and the condition of the land.

Harrow teeth are made from oil-tempered spring steel. The width and thickness of the teeth vary and depend on the expected use. There are four major types of teeth, which are:

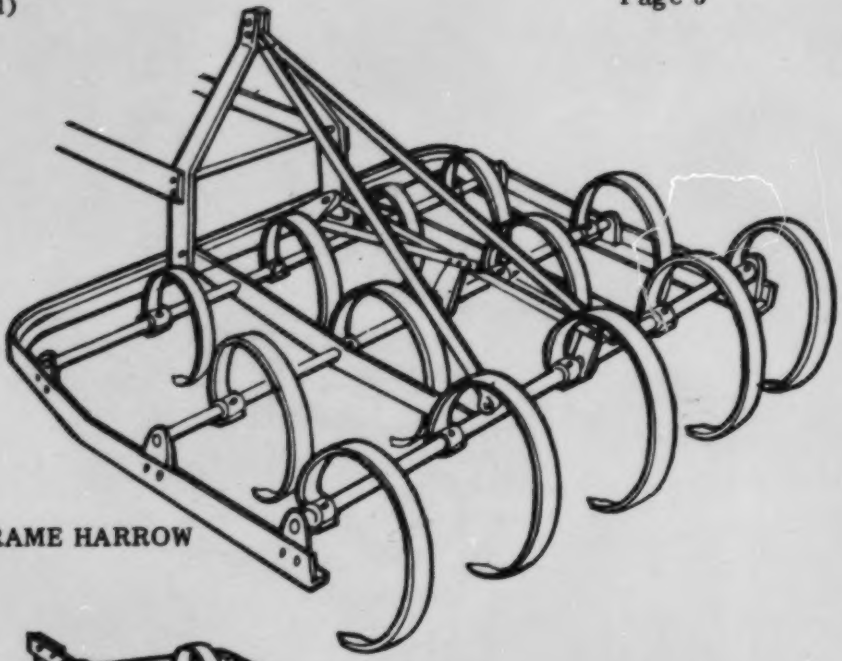
1. Regular
2. Quack grass
3. Alfalfa
4. Renewable-point

Spring-tooth harrows have few parts, and these vary with the type of implement. Some of the more common parts are:

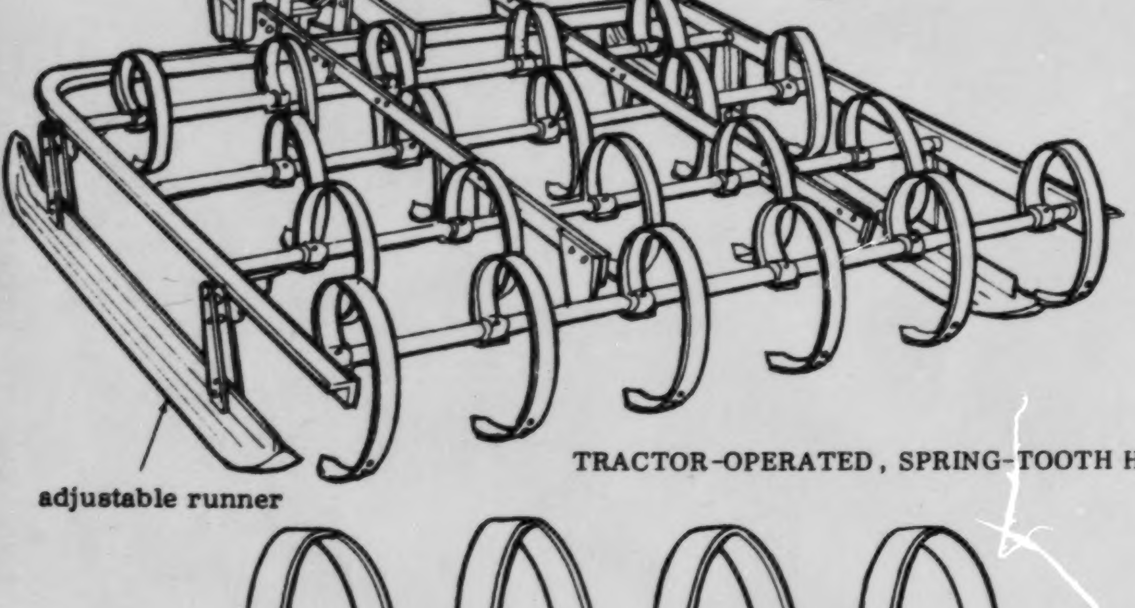
1. Teeth
2. Tooth bar
3. Tooth bar standard
4. Tooth bar clamps
5. Frame and shoes
6. Hitch and draft links
7. Transport wheels

Most models have a lever that moves the tooth bar to set the depth - one lever per section. All sections should be set evenly for uniform operation. The hitch should also be adjusted evenly to insure even depth both fore and aft.

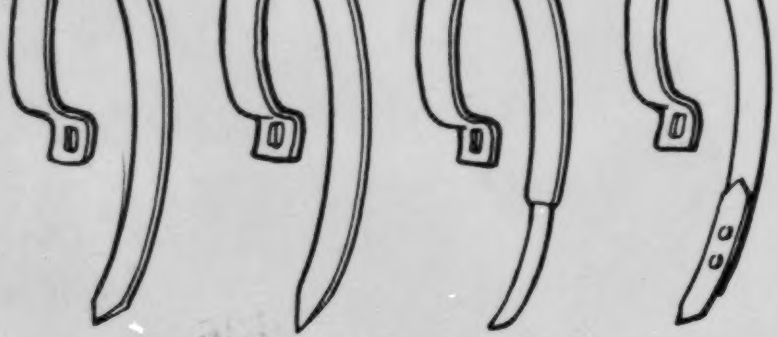
These harrows should be operated at a fairly slow speed for best results. One major disadvantage of them is that they plug easily in trashy fields. They are also light draft and therefore often economical to operate.



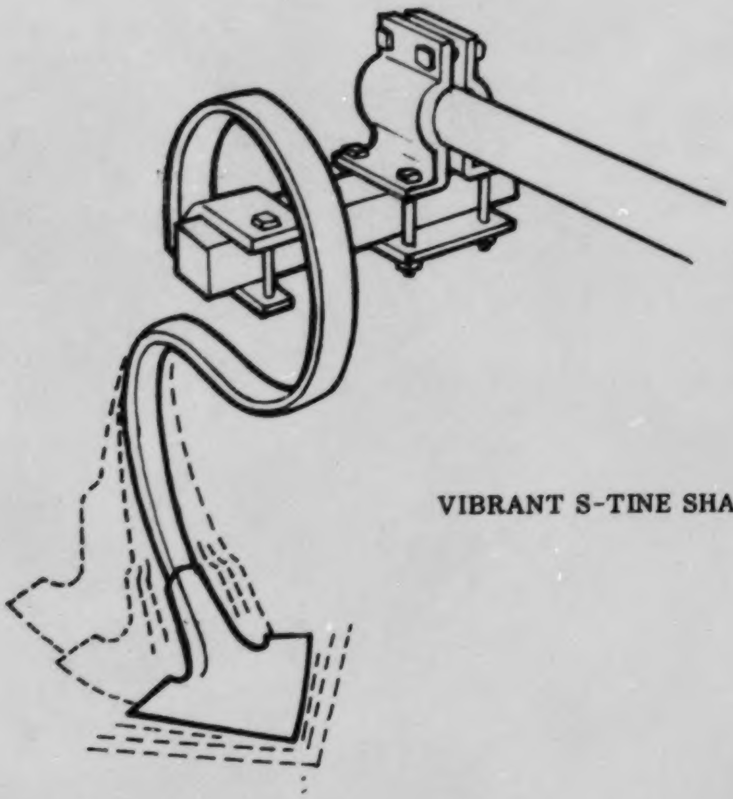
SINGLE-SECTION, ANGLE-FRAME HARROW



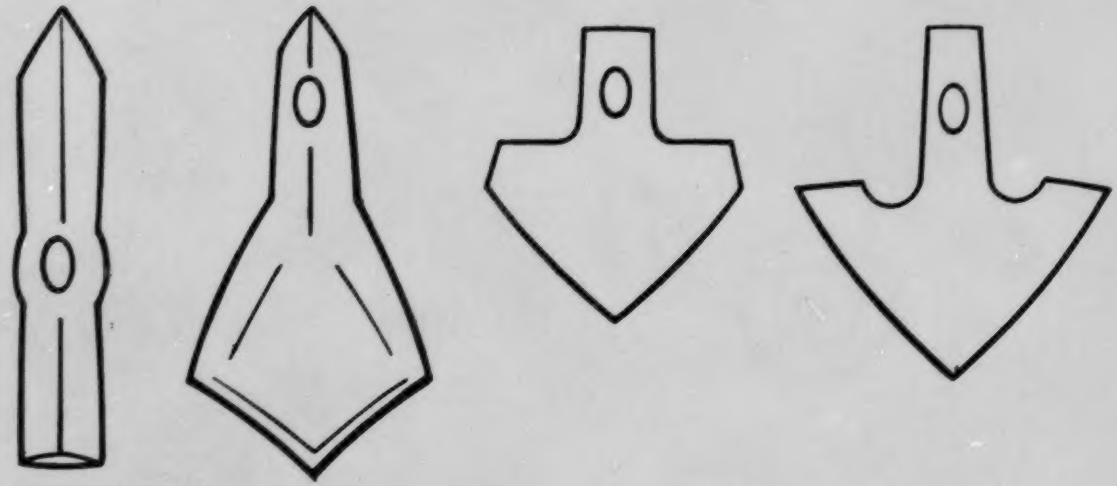
TRACTOR-OPERATED, SPRING-TOOTH HARROW



REGULAR, QUACK GRASS, ALFALFA,
AND RENEWABLE-POINT HARROW TEETH



VIBRANT S-TINE SHANK



SWEEPS

Assignment Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Secondary Tillage Equipment

TOPIC: Spike-Tooth Harrows

OBJECTIVE: To develop an understanding of the types and functions of spike-tooth harrows.

REFERENCES:

1. Machines for Power Farming, pp. 232-239
2. Farm Machinery and Equipment, p. 154
3. Information Sheet, "Spike Tooth Harrows"

QUESTIONS OR ACTIVITIES:

1. What is the purpose of a spike-tooth harrow?
2. List the two main types of spike-tooth harrows.
3. List the three types of frames used on spike-tooth harrows.
4. Give the various sizes of spike-tooth harrows.
5. Give the normal spacing of teeth on the spike-tooth harrow.
6. How are the teeth fastened to the bar?
7. List the main parts of a spike-tooth harrow.
8. What are the main differences between the operation of spring-tooth and spike-tooth harrows?

Information Sheet
on
SPIKE-TOOTH HARROWS

The spike-tooth harrow smooths and compacts the topsoil. It breaks up lumps and clods and is used prior to planting or to cover broadcast seed. It is excellent for pre-emergence cultivation because it breaks the crust and kills small weeds.

The two main types of spike-tooth harrows are rigid and flexible. The rigid has one-piece end rails which keep all bars at the same depth. The flexible has jointed end bars and allows the tool to cover the contour of the soil. Both can be purchased tractor mounted or tractor drawn. These are available in open end frames, square closed end frames, or curved closed end frames. The main disadvantage of the open end frames is that the protruding bars can snag obstacles. Like spring-tooth harrows, these come in sections ranging from 3 1/2 to 5 feet wide. When hooked together, these may be up to 30 feet wide. Due to the light draft of these harrows, power is not a problem. These sections weigh between 100 and 150 pounds. They are often pulled behind other tillage equipment to reduce the total number of trips over a field.

The optimum tooth spacing varies depending on the desired results. An average spacing is 9 inches, where with 5 bars the effective width between teeth is 1 4/5 inches.

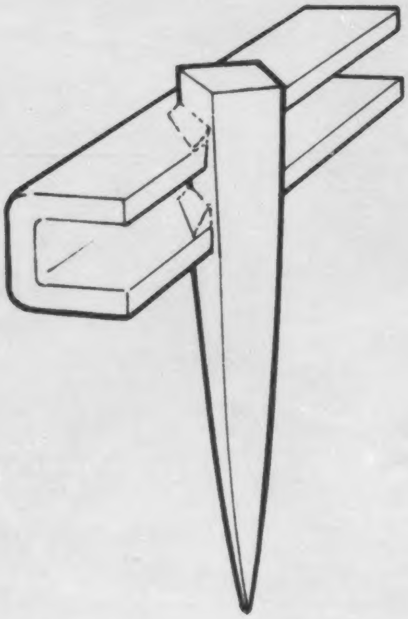
The teeth may be fastened to the bars in various ways. In some cases the bars are notched with the teeth being bolted on. The teeth may have collars so that loose teeth are not lost. Finally, teeth may be welded onto the bar.

The parts of the spike-tooth harrow vary with the type of harrow, but some of the parts common to most are:

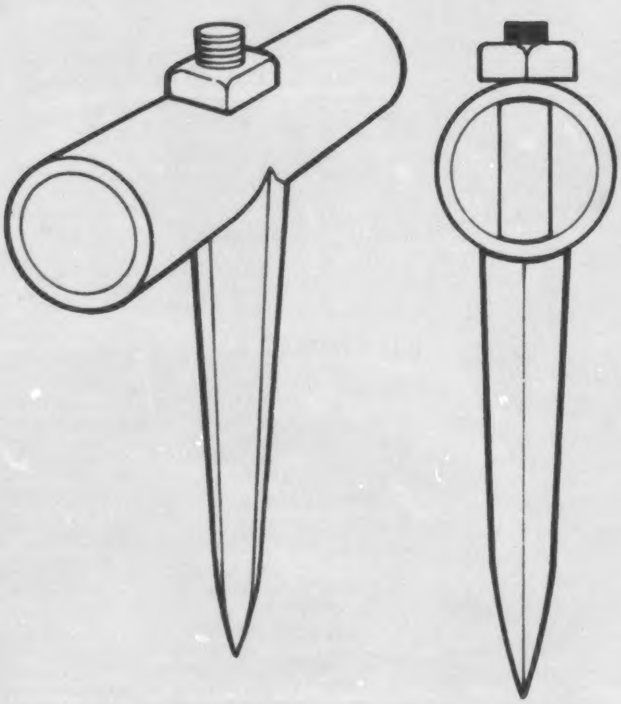
1. Spike tooth
2. Tooth bars
3. Tooth clamp
4. Frame
5. Adjusting levers
6. Drawbars

Spring and spike-tooth harrows may be used for similar operations; however, each does have its strong points and they should be used accordingly. Spring-tooth harrows penetrate the soil, pulling weed roots to the surface, mixing residue, and preparing the seedbed. The spike-tooth harrow, on the other hand, fills in low places, smooths the soil, breaks up clods, and covers broadcast seed.

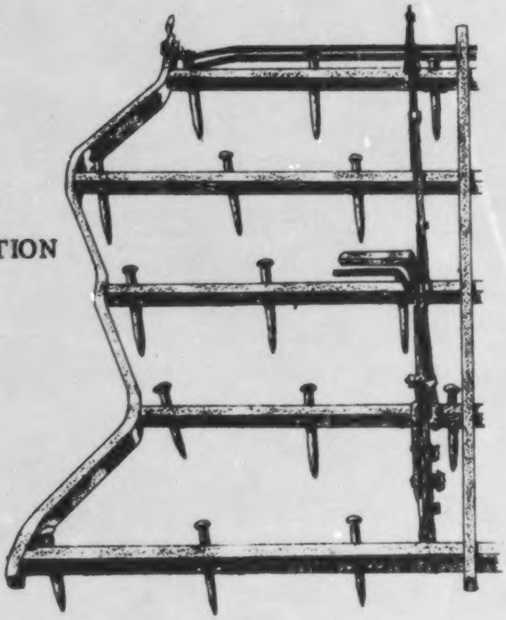
METHODS USED TO ATTACH TEETH TO BAR



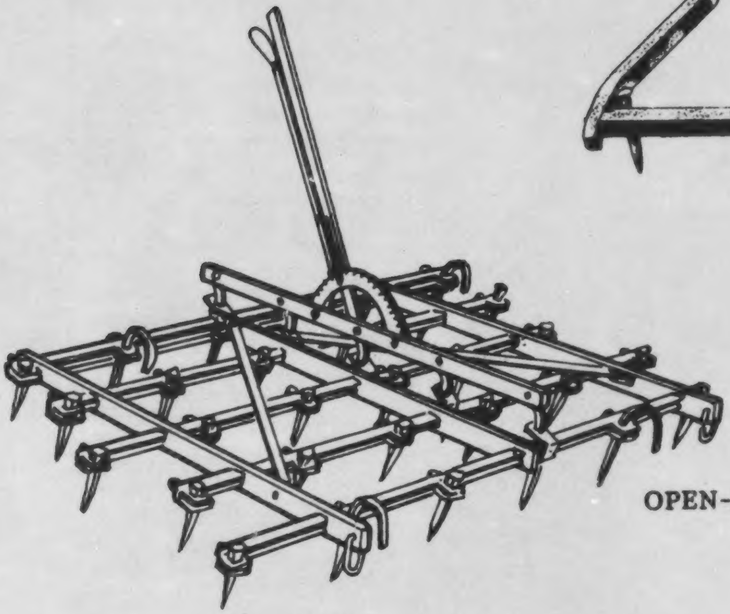
WELDED TEETH ARE DURABLE



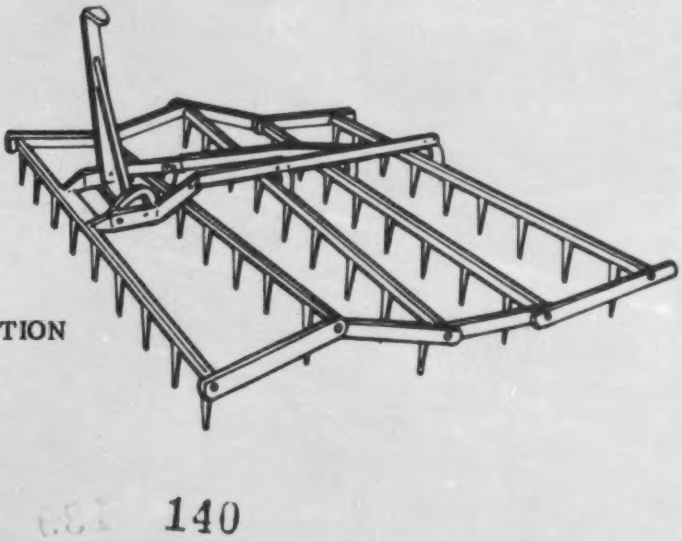
BOLTED TEETH USED FOR LONGER WEAR.



CLOSED-END SECTION



OPEN-END SECTION



FLEXIBLE-FRAME SECTION

Assignment Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Secondary Tillage Equipment

TOPIC: Land Rollers and Pulverizers

OBJECTIVE: To develop an understanding of the types, functions, and general purposes of land rollers and pulverizers.

REFERENCES:
1. Information Sheet, "Land Rollers and Pulverizers"
2. Machines for Power Farming, pp. 249-254
3. Farm Machinery and Equipment, pp. 157-161

QUESTIONS OR ACTIVITIES:

1. List the different types of tools used to put a finishing touch to the seedbed.
2. List the different types of wheels found on rollers and pulverizers.
3. What is the purpose of these tools which are used to put a finishing touch to the seedbed?
4. List the principal parts of land rollers and pulverizers.
5. Why are wood bearings used on land rollers and pulverizers?
6. Explain the differences between a packer and a mulcher.
7. Explain the operation of a treader packer.
8. What is the function of a subsurface packer and how does it operate?

Information Sheet
on
LAND ROLLERS AND PULVERIZERS

Land rollers, packers, pulverizers, and mulchers are all types of tools that put finishing touches on seedbeds. All of these break up clods, pack the soil, and in general prepare a more uniform seedbed.

These tools are equipped with different types of wheels to accomplish different jobs. There are four basic types of wheels: plain ridge, serrated, wavy, and sprocket. These wheels are made from either cast iron or pressed steel. The plain wheels are heavy but do not pulverize to any extent. Serrated and wavy edge wheels act much the same as plain with a slight increase in the amount of pulverization. Sprocket wheels are used mainly for this pulverization. These sprockets do not fit snugly, thus allowing more movement for maximum soil action.

Land rollers vary with their uses but there are some parts common to all. These are:

1. Wheels
2. Rollers
3. Sprockets
4. Frame
5. Bearings

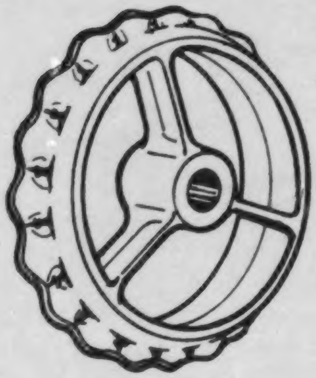
The bearings for this type of slow moving machinery may vary, but one popular type is the oil-soaked wood. These are cheap, easy to replace, and usually adequate for this equipment.

There are two main uses for these implements, as a packer or as a mulcher. A mulcher breaks the soil crust for better seed germination and also kills weeds by exposing their roots. Packers merely firm the soil and break clods.

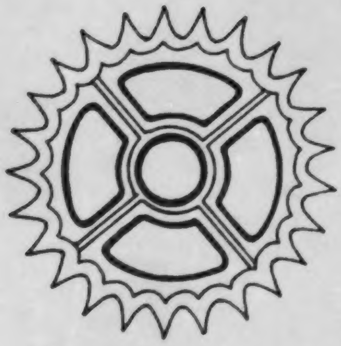
Another type of packer is a treader packer. This implement uses heavy rotary hoes. When pulled forward it pulverizes soil and destroys weeds. When pulled backward, it treads plant residue into the soil.

Subsurface packers are another variation of this implement. These tools press the soil together and leave a mulch on top for better moisture conservation.

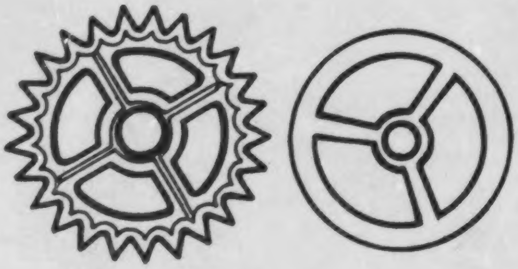
PACKER WHEELS



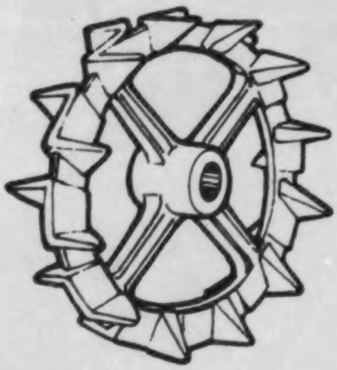
Sprocket-tooth wheel



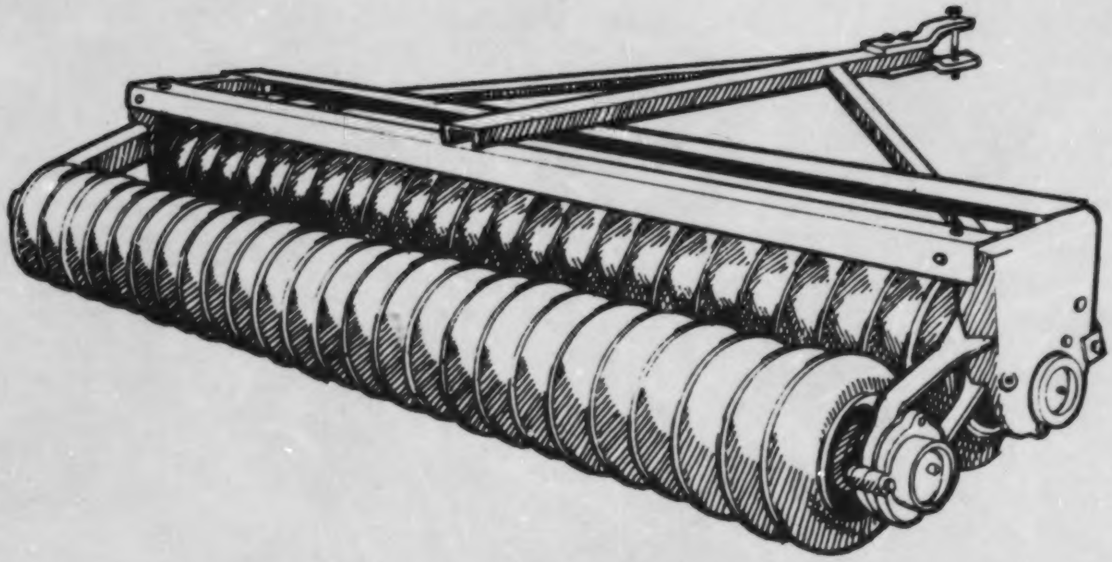
Serrated wheel



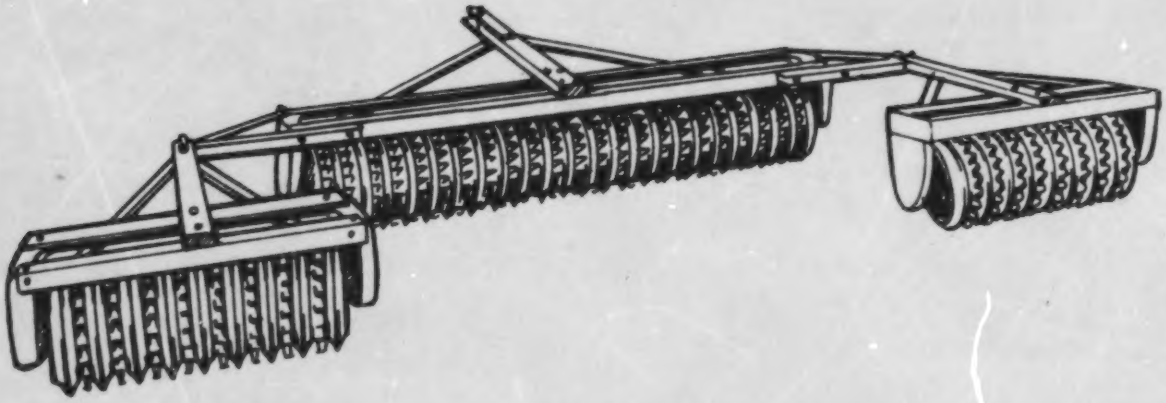
SPROCKET HUB AND ROLL
FIT CLOSE TOGETHER



CROWFOOT ROLLER



SEEDBED TANDEM PULVERIZER



SPROCKET-WHEEL PULVERIZER

Assignment Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Secondary Tillage Equipment

TOPIC: Rotary Hoes

OBJECTIVE: To develop an understanding of the function of a rotary hoe.

REFERENCES:

1. Information Sheet, "Rotary Hoes"
2. Machines for Power Farming, pp. 353-358
3. Farm Machinery and Equipment, pp. 223-224

QUESTIONS OR ACTIVITIES:

1. Explain the importance of a rotary hoe in the cultivation program.
2. What happens to the soil when the rotary hoe is pulled backward?
3. Describe the two types of rotary hoes.
4. What makes up gangs and sections on the rotary hoe?
5. List several crops that are cultivated by the rotary hoe.
6. How should a trailing-type hoe be transported?

Information Sheet
on
ROTARY HOES

The rotary hoe is a tillage tool that may be used either before or after emergence of plants. Either of the two uses may be accomplished without damage to the crop. The rotary hoe shatters, feathers, tears, chops, mows, pulverizes, spreads, and mulches any foreign material so that it may be returned to the soil. This implement may also be pulled backward. This produces less tillage and more packing.

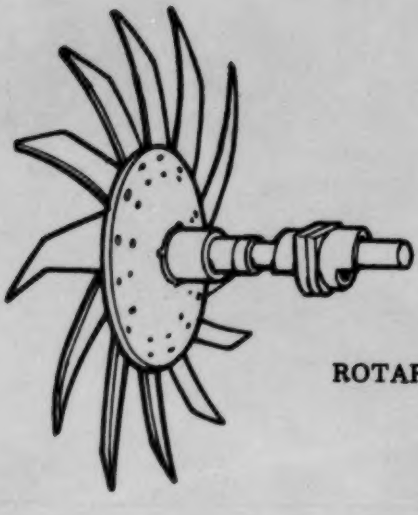
There are two main types of rotary hoes, mounted and trailing. Mounted hoes are transported and adjusted by the hydraulic system of the tractor. Trailing hoes are either transported on wheels or they may be pulled backward on roads if they are not wheel equipped.

Rotary hoes are made up of gangs, two gangs per section, and up to twelve sections per implement. Gangs consist of about seven wheels, spread equelly. Each wheel rotates independently of the others. Section widths vary from 36 to 46 inches depending on the row width to be cultivated.

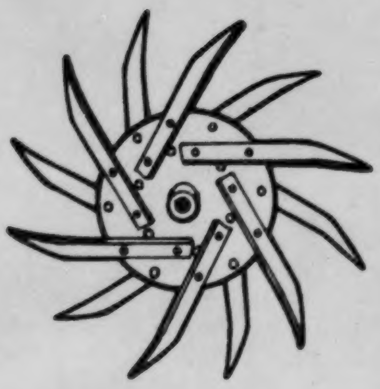
Many different types of crops may be cultivated with a rotary hoe. Some of these are:

1. Cotton
2. Corn
3. Peas
4. Beans
5. Sorghums

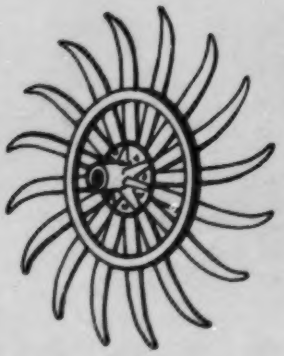
These implements should be pulled at fairly high rates of speed. They work best between 8 to 12 miles per hour. In order to insure maximum weed and grass control they should be used when plants are just emerging before a root system is developed.



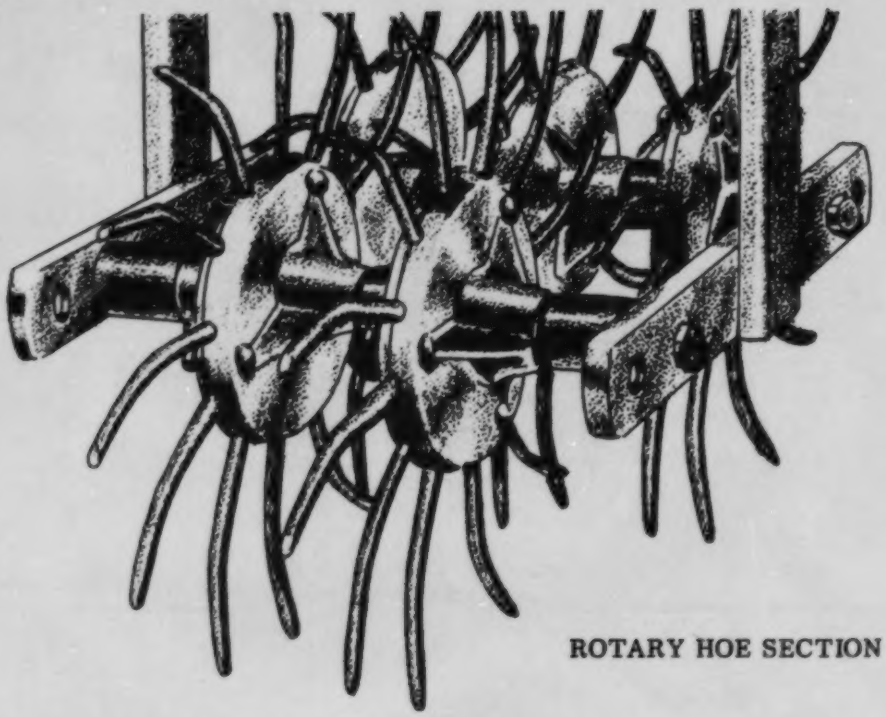
ROTARY HOE WITH TEETH RIVETED TO HUB



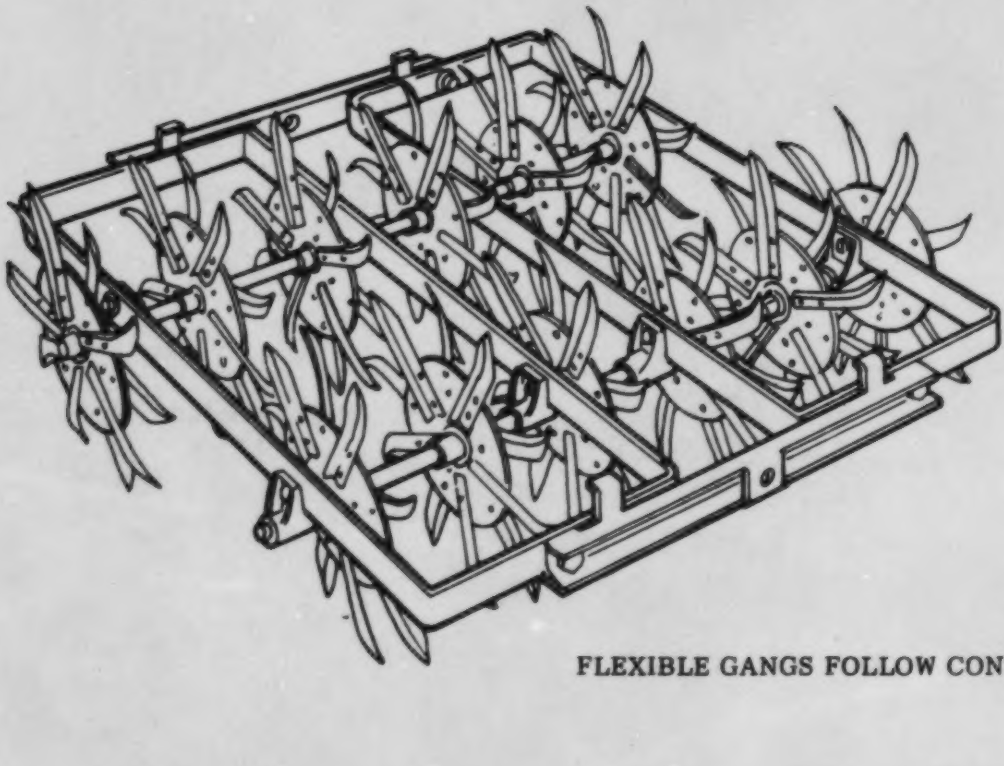
SIDE TEETH ON WHEEL



RING TYPE OF HOE WHEEL



ROTARY HOE SECTION



FLEXIBLE GANGS FOLLOW CONTOUR

Assignment Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Planting Equipment

TOPIC: Grain Drills

OBJECTIVE: To develop an understanding of the types and functions of grain drills and to understand the different parts and how they operate.

REFERENCES:

1. Information Sheet, "Grain Drills"
2. Machines for Power Farming, pp. 311-331
3. Farm Machinery and Equipment, pp. 196-208

QUESTIONS OR ACTIVITIES:

1. What is the purpose of the grain drill?
2. Name several types of grain drills.
3. Give the three ways drill sizes are expressed.
4. Name the common sizes of most grain drills.
5. List four things one can change that affect the sowing rate on a double-run drill.
6. List three things which regulate the sowing rate of the fluted force-feed drill.
7. List the four types of furrow openers.
8. List the major parts of a grain drill.

VOCULABARY: The following key words or terms have been used in this assignment and should now be a part of your vocabulary. Explain or define each.

Run
Spacing

Information Sheet
on
GRAIN DRILLS

Grain drills are used to sow crops in narrow rows too close to each other to permit cultivating or other cultural practices. This is sometimes called solid-planting. This type of planting is normally used on grain crops such as wheat, oats, barley, rye, rice, grain sorghum, and grasses and legumes. The drill's purpose is to sow seeds in the correct amounts, at the proper depth, and to firm the soil.

There are several types of drills designed for different purposes. These are:

1. End wheel type
2. Trailing press wheel
3. Fertilizer drill

These drills have either of two types of feeds:

1. Fluted feeds
2. Double-run feeds

The double run type is suitable for sowing large seed such as peas or corn as well as the customary small grain seeds. Depending upon the side of the metering plate used, either size may be sown accurately. With this type of feed there are four things that may be adjusted to alter the seeding rate:

1. Select side of wheel recommended on seeding chart.
2. Change speed of wheels by changing gears, sprockets, or both.
3. Change the position of the feed gate in the cup.
4. Use reducers below the feed wheel.

The fluted-force-feed is most commonly used for small grains and grass seeding. This seeding mechanism may be controlled in three ways:

1. Moving the fluted wheel endways
2. Adjusting the gate or latches to one of three positions
3. Changing the speed of the feed shaft

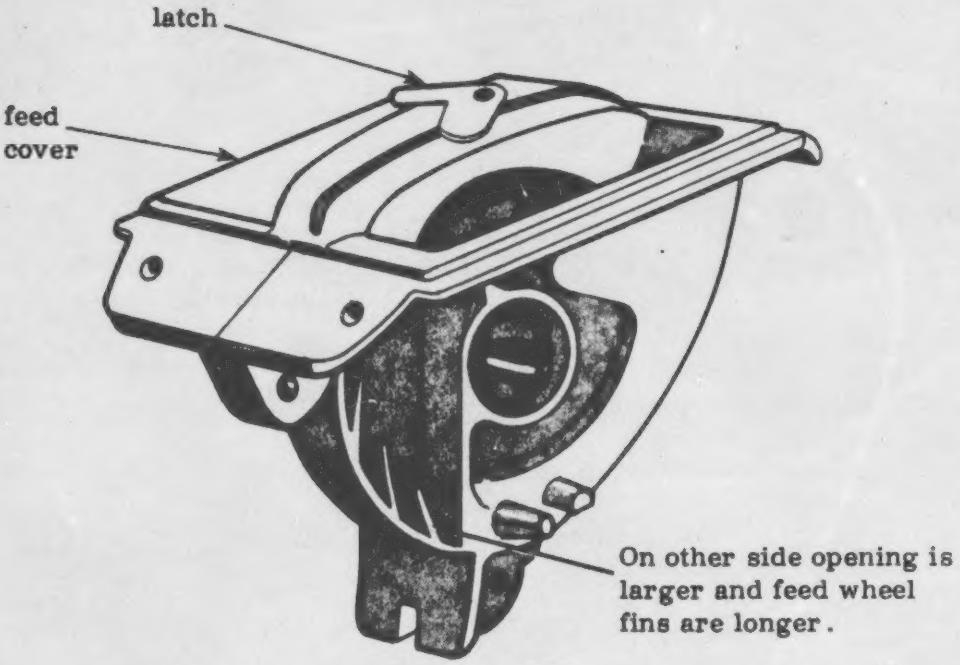
Grain drill sizes are expressed in three ways; width in feet, number of furrow openers, and the distance between the runs. The run is the distance between furrow openers. Common widths are 6, 7, 8, 10, 12, 14, and 16 inches, with seven inches being the most popular. The number of furrow openers varies from 5 in a corn row drill to 24 in the larger types. Width of the drill varies but normally ranges from 9 to 15 feet.

Another important device found on drills is the furrow opener. The style of these varies with the demands of the job, but there are four general types:

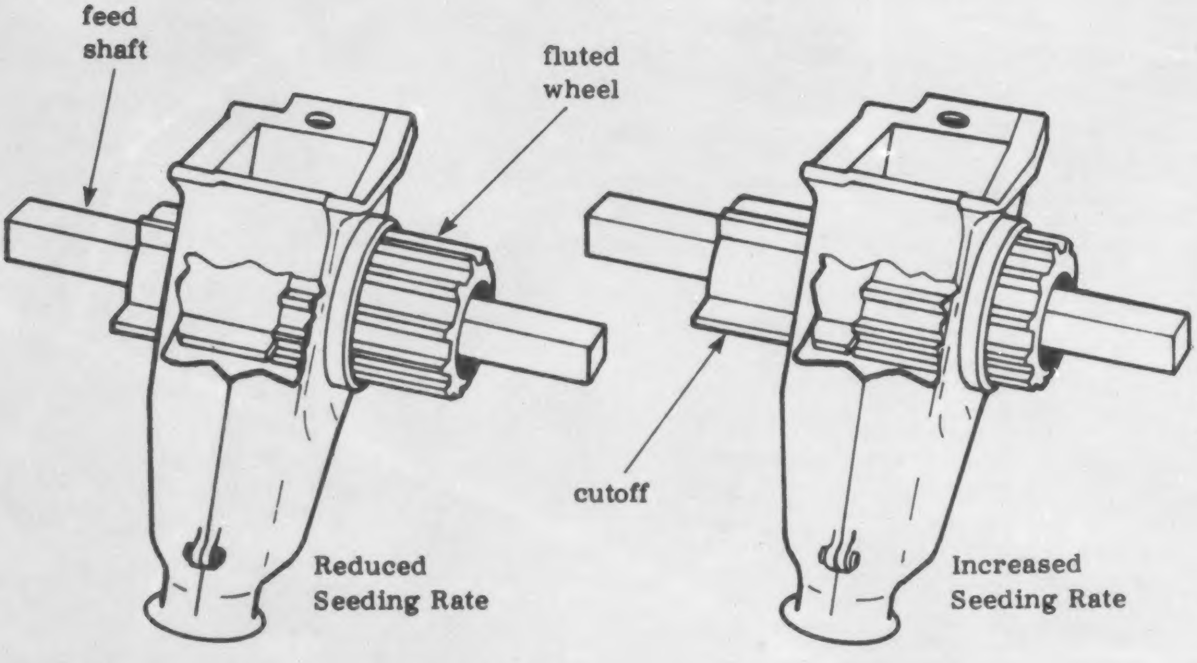
1. Sliding furrow openers - these are more common in older horse drawn drills.
2. Hoe or horn furrow opener - here the seed tube has a replaceable shovel point on it.
3. Shoe or runner opener - this wedge - shaped runner will work in light trash. It is for shallow planting only.
4. Rolling furrow openers - these are the most popular and will cut heavy trash. There are several types:
    A. Single disk with open-delivery boot
    B. Single disk with closed-delivery boot
    C. Lister opener
    D. Double disk coulter opener
    E. Double disk curved-blade opener

According to design, most grain drills vary but there are some parts common to most:

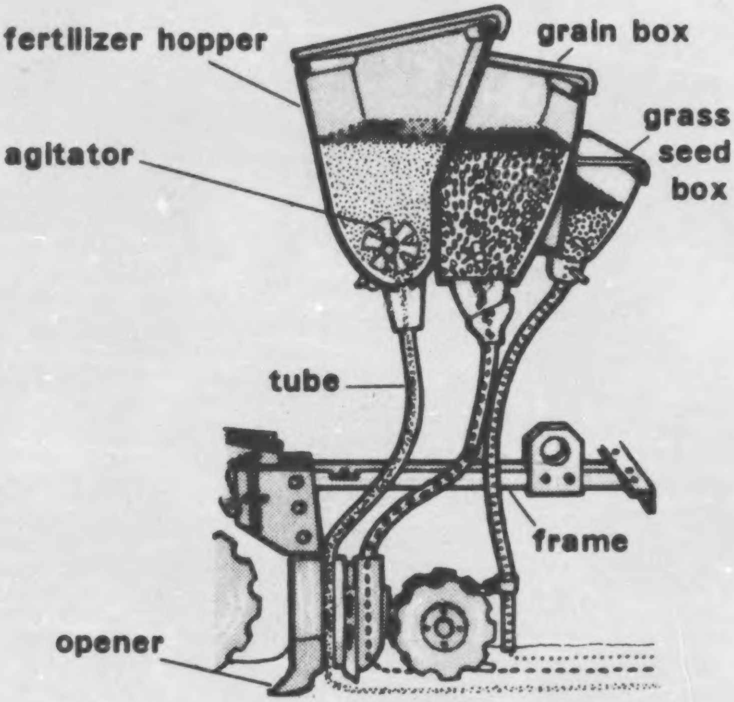
1. Feeding devices
2. Furrow openers
3. Drag bars
4. Seed coverers
5. Frame
6. Wheels
7. Axles
8. Hoppers
9. Fertilizer devices
10. Grass-seeding attachment


latch
feed cover
On other side opening is larger and feed wheel fins are longer.

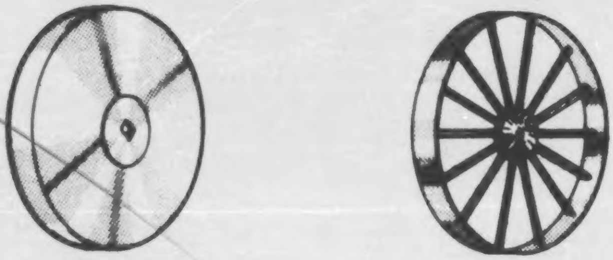
PARTS OF DOUBLE-RUN FEED


feed shaft
fluted wheel
cutoff
Reduced Seeding Rate
Increased Seeding Rate

FLUTED FEED SEEDING RATE ADJUSTMENT

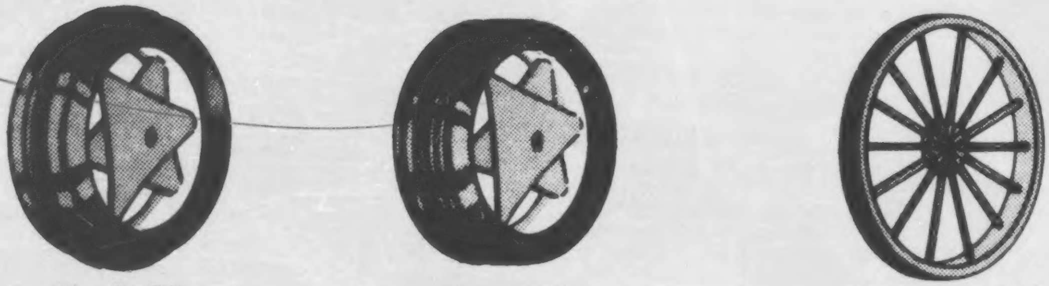

fertilizer hopper
grain box
grass seed box
agitator
tube
frame
opener

CROSS-SECTION OF MULTIPLE-PURPOSE DRILL



Solid

Spoke

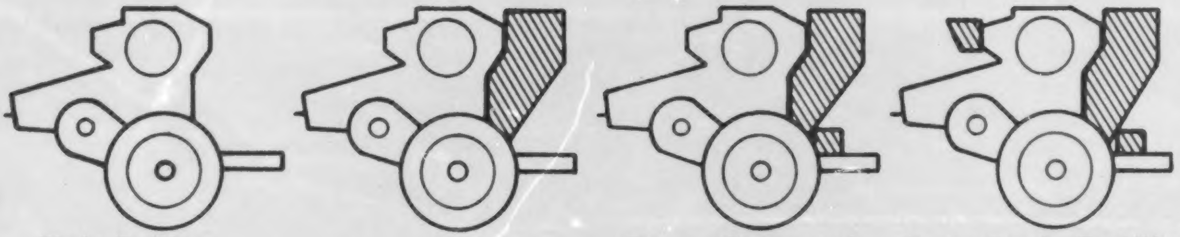


Single Rib

Pneumatic

Semi-Pneumatic

WHEELS FOR PRESS-WHEEL DRILLS



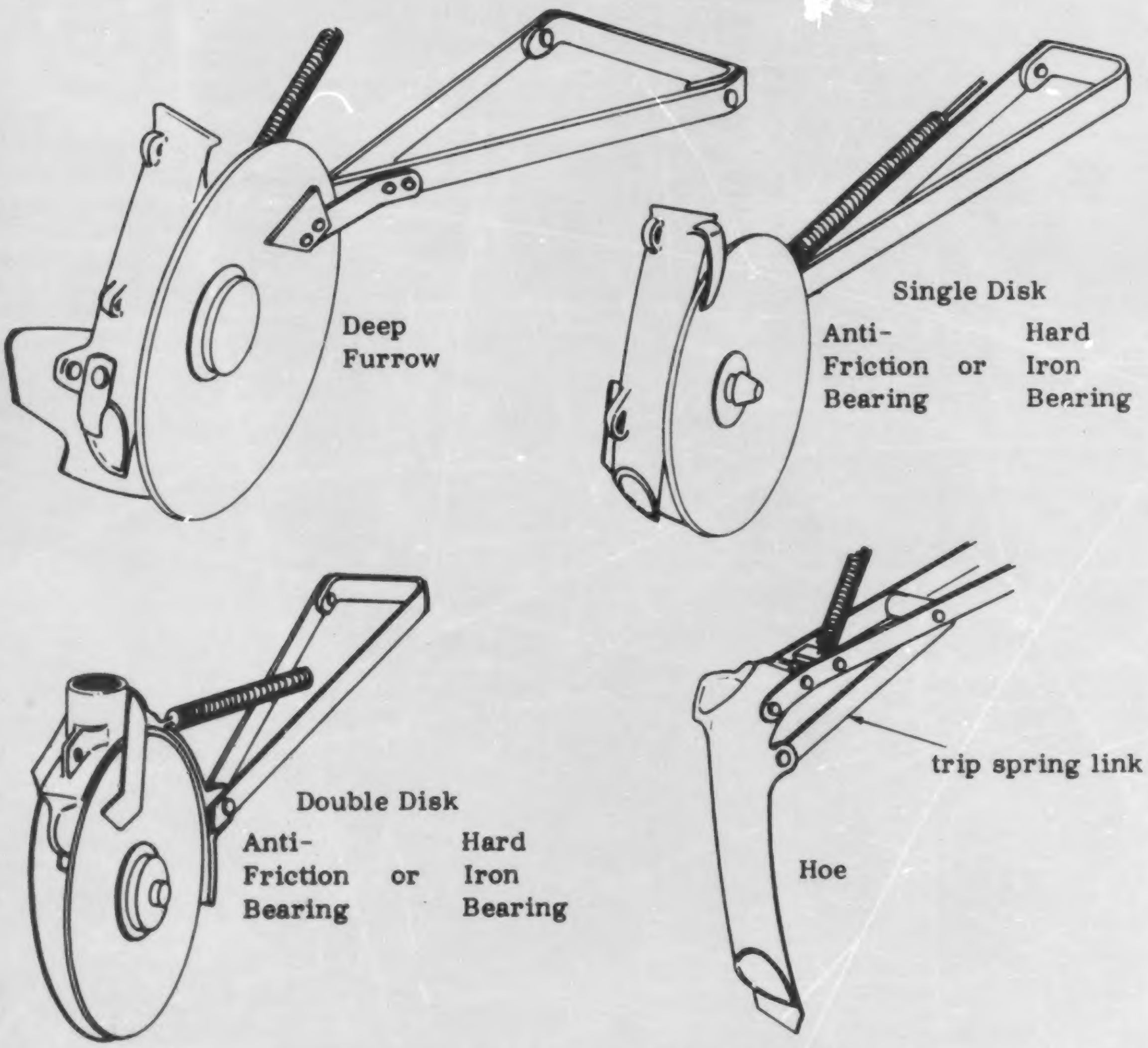
Plain Drill
No Attachments

Fertilizer Drill

Brome Grass and
Fertilizer Drill

Grass Seed, Fertilizer
and Brome Grass Drill

END VIEWS OF GRAIN DRILLS AND LOCATION OF FERTILIZER AND GRASS ATTACHMENTS



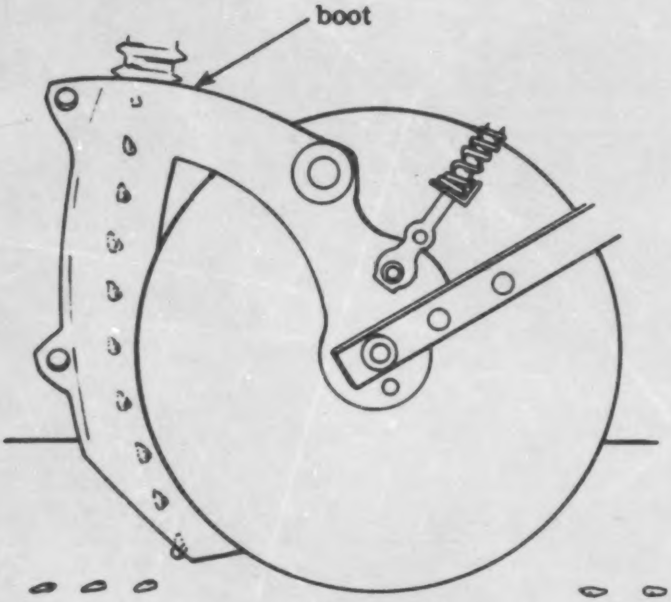
Deep
Furrow

Single Disk
Anti-
Friction
Bearing
or
Hard
Iron
Bearing

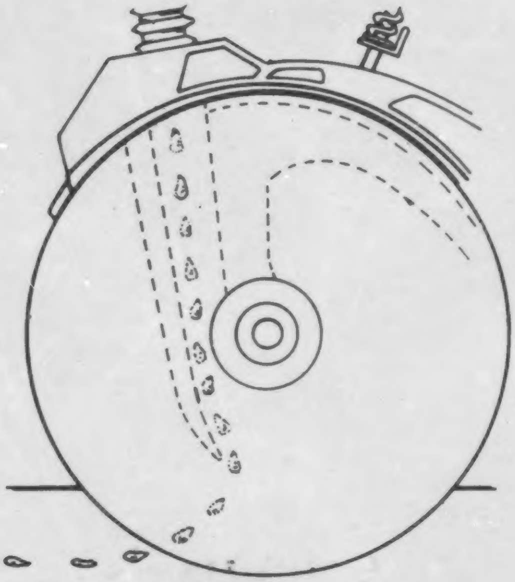
Double Disk
Anti-
Friction
Bearing
or
Hard
Iron
Bearing

Hoe

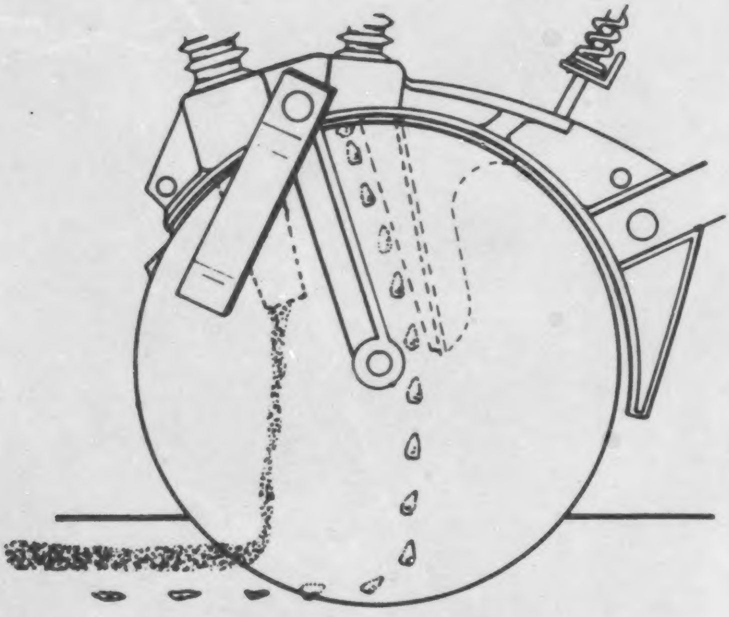
TYPES OF FURROW OPENERS FOR GRAIN DRILLS



DISK OPENER WITH
CLOSED DELIVERY BOOT



DISK OPENER WITH
OPEN DELIVERY BOOT



DOUBLE-HOLE BOOT

Assignment Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Planting Equipment

TOPIC: Row-Crop Planters

OBJECTIVE: To develop an understanding of the types, sizes, and functions of row-crop planters and to understand the major parts of row-crop planters' operations.

REFERENCES:

1. Information Sheet, "Row-Crop Planters"
2. Machines for Power Farming, pp. 291-310
3. Farm Machinery and Equipment, pp. 169-195

QUESTIONS OR ACTIVITIES:

1. List the two main types of row-crop planters.
2. Of the two types of planters, some are trailing and some are mounted. Name the two ways mounted planters may be placed on the tractor.
3. List the four types of hoppers found on row-crop planters.
4. The seed plates are the heart of the planter, and hundreds of different plates are available. Each plate is made for a certain variety and size of seed. All can be placed in three groups according to the arrangement of the cells. Name these three groups.
5. Name the four variables in securing a good stand of any crop.
6. List the four planting methods.
7. List the major parts of a row-crop planter.
8. Name the two types of furrow openers.
9. List the different types of constant-depth openers.
10. List the types of furrow coverers available on row-crop planters.

Information Sheet
on
ROW-CROP PLANTERS

A row crop planter sows seeds in rows on beds, in furrows, and on flat land. The seed is deposited evenly in drills or hills, at the correct depth, and is then covered and the soil firmed.

There are two main types of row crop planters, regular drill planters and checkrow planters. Regular drill planters can place seed from 3 1/2 to 258 inches apart. This type of planter is the most versatile, allowing even distribution in crops with seeds of varying sizes. The outmoded checkrow planter plants on a square. This type of planting permits good weed control but has lost its popularity because:

1. It required too much time.
2. It required longer wires due to increased field length.
3. Hybrid varieties were developed which grow ahead of weeds.
4. Of development of herbicides.

This type of planter can also be converted into a hill or drill type planter.

Planters may be either the trailing or mounted type. The mounted may be front mounted or rear mounted. The front mounted planter has mounting brackets that will fit only one make of tractor. The rear mounted planters are becoming the most popular. These are hooked up to a three point hitch, allowing ease of attachment and versatility in the field. With this type planter the boxes and openers are mounted to a toolbar. This arrangement allows a wide choice of row spacings. Another advantage of the rear mounted type is that front mounted tillage equipment may be used with it.

Row crop planters may have any of 4 types of hoppers; (1) single-seed, (2) reverse-feed cotton hopper, (3) Richmond hopper, and (4) duplex hopper. The single-seed plants well with delinted cottonseed (acid delinted) or with the proper plates may also be used for other crops. The reverse-feed cotton hopper plants only cotton and does well with machine delinted seed. The Richmond planter is mainly used for corn and other hybrid seed. The duplex hopper will plant nearly all seeds except cotton. It can also be used to sow two different seeds at once.

The single most important part of these planters is the seed plate. Hundreds of different plates are available for each size and shape of seed. There are three main types of plates according to seed cell types:

1. Full hill drop plate
2. Single cell drop plate
3. Edge drop plate

Row-Crop Planters
(Information Sheet continued)

When used in a drill planter, a full hill drop plate allows it to plant in hills. Single cell drop plates allow it to plant one cell at a time. When buying this type of plate it is a good idea to take a sample of your seed to your dealer to acquire the exact plate. The edge drop plates are the most popular for corn. Here the thickness of the plate is the most important factor.

When planting a crop there are many variables that determine the quality of the stand. Four of the most important are:

1. Soil tilth
2. Soil moisture
3. Kind of seed
4. Local practices

In order to meet these variable conditions seeds are planted in four different ways:

1. Bed planting - seeds are planted on top of beds.
2. Furrow planting - seeds are planted in the furrow between beds.
3. Flat planting - seeds are planted in cultivated flat soil.
4. Blackland planting - seeds are planted in beds previously made by middlebusters.

Over the years planters have changed as new practices have been adopted. Some of the parts have been altered, but most planters still have these basic components:

1. Hoppers
2. Planter drive mechanism
3. Furrow openers
4. Furrow coverers
5. Driving devices
6. Wheels
7. Axles
8. Frame
9. Markers
10. Power lifts
11. Planter hitches

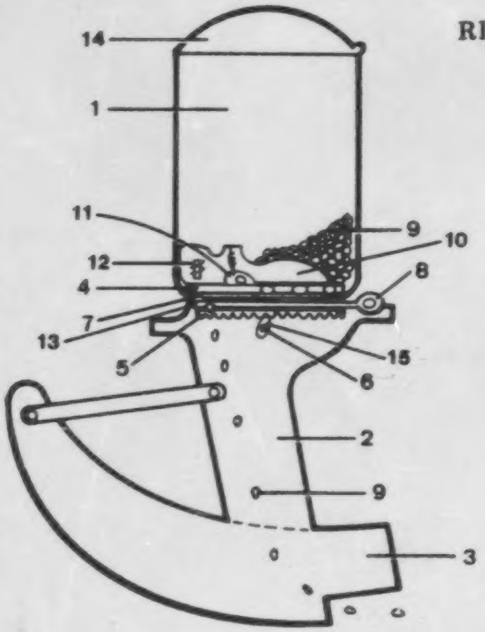
Furrow openers are divided into two types depending on their design. They are either variable depth or constant depth openers. The variable depth is used for cottonseed. By planting the seed at different levels there is more chance of getting a stand if conditions get unfavorable. Constant depth openers consist of shovels, runners, and disks, and are the most widely used. The type used should be based on local conditions and the type of crop to be planted. The different types and their uses are:

1. Curved runner - used for cotton and corn.
2. Fully curved runner - rides over trash in prepared seedbeds.
3. Stub runner - plows through and cuts trash.
4. Shovel opener - often used behind sweep or middlebuster.
5. Single disk opener - works best on hard or stony soils.
6. Curved double disk - wide furrow, works best in trashy soils.
7. Coulter double disk - makes uniform depth furrow even in trash soils.

Like furrow openers, furrow coverers should be suited to the soil. Some different types of these and their uses are:

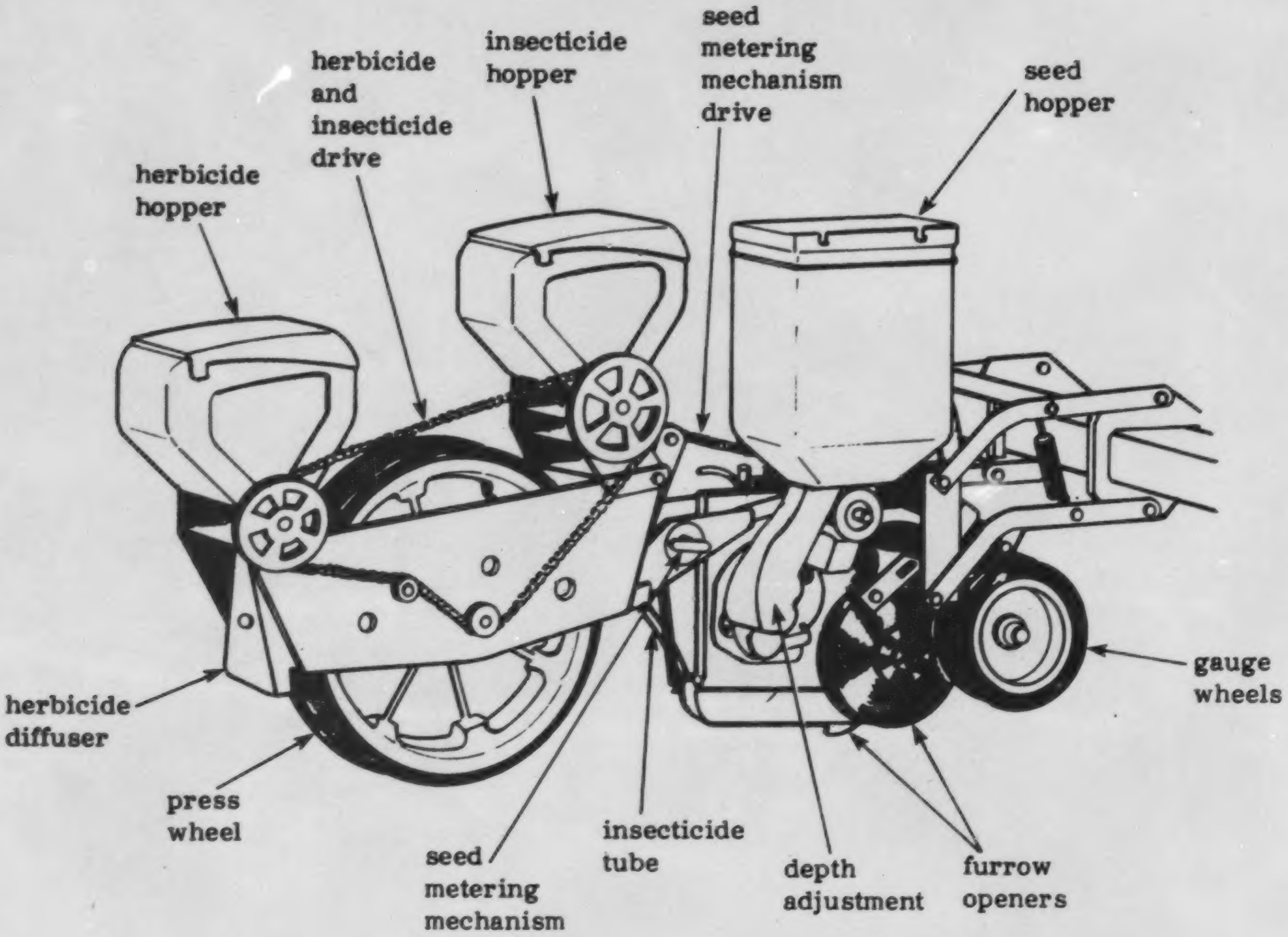
1. Open center press wheel - source of power for planter, firms soil around seed but not directly over it.
2. Rubber tired press wheels - carry only 3 to 5 pounds of pressure, work well in sticky soils.
3. Zero pressure rubber tires - conform to the contour of the soil.
4. Disk coverers - mound the soil slightly.
5. Blade coverers - used with single disk openers.
6. Shovels - move sod-free soil over furrow.
7. Knife blade coverer - used when small amounts of soil need to cover seed.

Markers are used with these planters to allow accurate parallel rows.

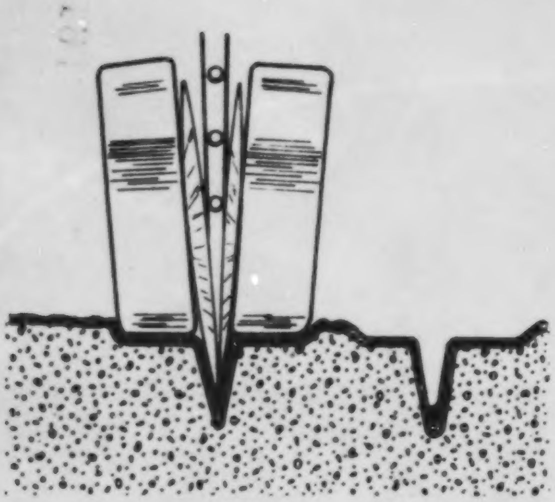


RICHMOND PLANTER HOPPER

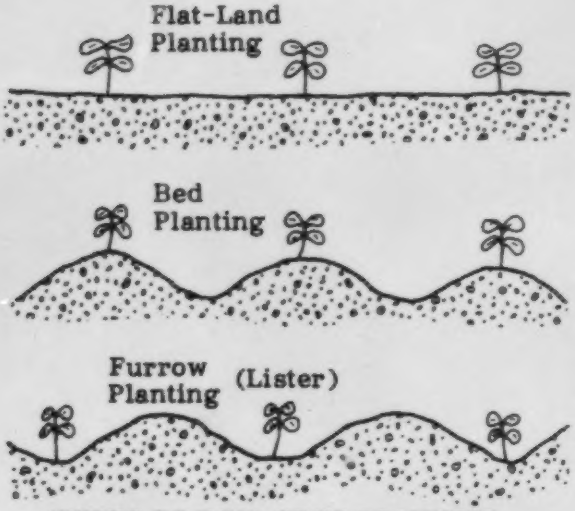
1. Richmond hopper can
2. Shank, foot, or post
3. Runner opener
4 Seed plate
5. Ring gear
6. Drill shaft
7. Filler plate
8. Hopper hinge
9. Seeds
10. Crowned bottom
11. Cut-off
12. Knocker
13. False-bottom plate
14. Lid
15. Two-gear section of variable drop pinion


herbicide hopper
herbicide and insecticide drive
insecticide hopper
seed metering mechanism drive
seed hopper
gauge wheels
herbicide diffuser
press wheel
seed metering mechanism
insecticide tube
depth adjustment
furrow openers

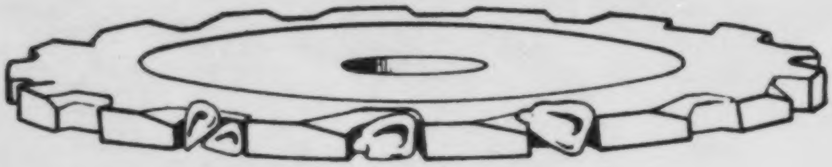
COMPONENTS OF A PLANTER



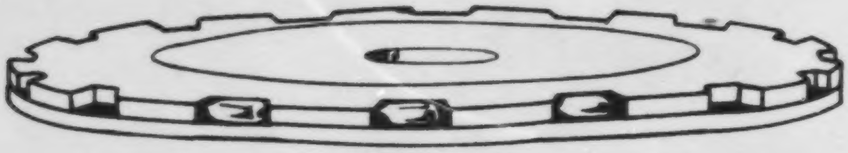
SEEDBED FURROW OPENER


Flat-Land Planting
Bed Planting
Furrow Planting
(Lister)

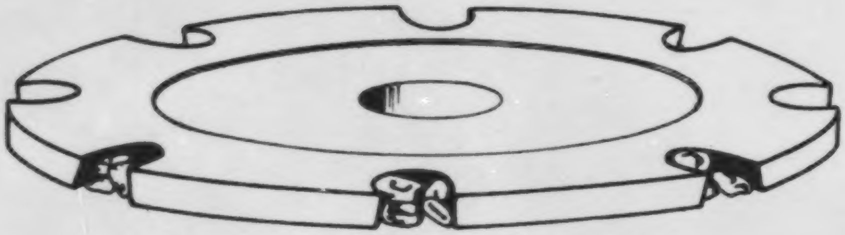
TYPES OF ROW-CROP PLANTING



EDGE-DROP



FLAT-DROP



FULL-HILL-DROP

TYPES OF SEED PLATES FOR CORN

Assignment Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Cultivating and Weed Control Equipment

TOPIC: Introduction

OBJECTIVE: To develop an understanding of the types of weed control and their importance in a farming operation.

REFERENCES:

1. Information Sheet, "Introduction"
2. Farm Machinery and Equipment, pp. 209-236
3. Machines for Power Farming, pp. 335-351

QUESTIONS OR ACTIVITIES:

1. What are the farmer's primary tools for controlling weeds?
2. Tell how weeds rob the farmer.
3. Briefly explain the history of cultivation.
4. Why is cultivation practiced before and after planting a crop?

Information Sheet
on
INTRODUCTION

Controlling weeds in crops has been a problem as long as man has been growing them. The first method used was by stirring the soil with a stick, then with a hoe, and now with specially designed plows. Using fire is another alternative. By directing the flame to the weeds and away from the crop, weeds can be controlled in many cases. More recently, chemicals have been used in weed control. This cuts down on the total number of trips over a field, because chemicals may be applied while performing another operation such as bedding or planting. They can also be flown on when the field is too wet for a tractor.

Weeds and grasses are a real nuisance to a farmer. They can cause severe problems and cost the farmer his entire livelihood. Some of the ways weeds rob the farmer are:

1. Reducing yields
2. Harboring insects
3. Lowering crop quality
4. Reducing land value
5. Destroying crops

In order to prevent this, man started many years ago to develop methods of weed control. The first tool used for weed control was probably the hoe. As time passed there was a need for a faster, cheaper method of cultivation. The first actual cultivator was invented in 1837. In 1878 the sulky cultivator came into use. In 1905 the one-horse walking cultivator with two bottoms came into use. In 1923 a great change occurred. The first tractor type mounted cultivator was introduced, and mechanized cultivation really began.

Cultivation is carried on both before and after planting for these reasons:

1. Control weeds
2. Aerate the soil
3. Retain moisture
4. Mulch the soil
5. Promote microorganism growth

Vocational Instructional Services
Agricultural Education

Assignment Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Cultivating and Weed Control Equipment

TOPIC: Cultivators

OBJECTIVE: To develop an understanding of the types, purposes, parts, and operation of cultivators to control weeds.

REFERENCES:

1. Information Sheet, "Cultivators"
2. Farm Machinery and Equipment, pp. 209-226
3. Machines for Power Farming, pp. 335-352

QUESTIONS OR ACTIVITIES:

1. List the types of cultivators.
2. List the three primary objectives of cultivators.
3. Name the major parts of a cultivator.
4. Name the two major types of sweeps used on cultivators.
5. Name the different types of sweeps available.
6. Name the parts of a sweep.
7. List the different types of shovels available.
8. What is the function of standards?
9. List the types of frames available for cultivators.
10. How is a cultivator operated for best results?

Information Sheet
on
CULTIVATORS

Cultivators must be adapted to the specific crops, soils, and field characteristics in order to operate properly. The two main types of cultivators are row crop and field. Both types may be mounted on the tractor or may be trailing. The mounted cultivator for row crops may be either front or rear mounted.

All cultivators, whether row crop or field, have three primary objectives which they are designed to meet. These are:

1. To retain moisture by killing weeds which use water, loose mulching on the surface to reduce evaporation, and retaining rainfall or irrigation water.
2. To aerate the soil for oxygen penetration.
3. To promote activity of microorganisms.

In order to accomplish these objectives most cultivators are made up of three basic parts:

1. Ground engaging equipment
2. Standards
3. Frame

The ground engaging equipment may be sweeps, shovels, spikes, disks, knives, or hoes. The main types of sweeps and their uses are:

1. Blackland - heavy soils
2. Mixed-land - light soils, high speed
3. Planting - for clearing seedbeds
4. Duckfoot - for heavy rooted weeds

Sweeps are made up of four principal parts; stems, crowns, points, and wings. The shape of each of these varies with its intended use.

Shovels are not winged and are used for deep cultivation, or they are used to leave the soil surface grooved in small furrows. The main types of shovels are:

1. Spear point
2. Irrigation
3. Arrowhead
4. Chisel tooth
5. Turn shovel

The spikes are most often used on field cultivators. Disks are used in fields where heavy trash is a problem. Knives and hoes are most commonly used for vegetable work.

Cultivators
(Information Sheet)

Standards connect the points with the frame. Types vary with the soil conditions, but the most common are:

1. Stiff standards
2. Spring-trip standards
3. Friction-trip standards
4. Pin-break standards
5. Flexing or spring-tine standards

Cultivator frames, like the points and standards, also vary with their use. The four most common types and their characteristics are:

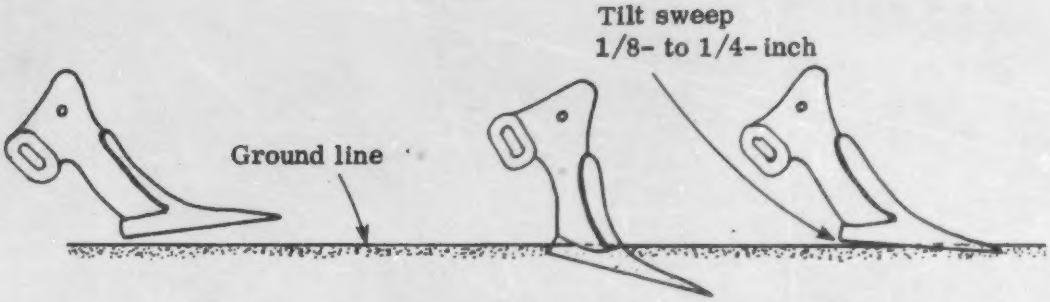
1. Side-mounted front gangs - provide the best observation of the work.
2. Rear-mounted toolbar - easy to attach and change row spacings, versatile.
3. Rear-mounted frame cultivator - uses a steering fin or disk to move cultivator with the front wheels.
4. Trailing frames or carriers - used for field cultivators, may be used for heavy work.

Cultivation is an effective tool for weed control only if it is done properly. Therefore, when cultivating it should be remembered that maximum benefits result when:

1. Weeds and grasses are small.
2. It is done on dry, hot days.
3. It is done at relatively high speeds (4-6 mph).
4. It begins on matching rows.

Different types of tools may be attached to the cultivator to decrease some of the trips necessary in farming. Some of these are:

1. Rotary hoe
2. Rotary shield
3. Disk tillers
4. Fertilizer attachments
5. Seeders
6. Ammonia applicators
7. Nitrogen applicators
8. Weeder-mulchers
9. Row-crop thinners

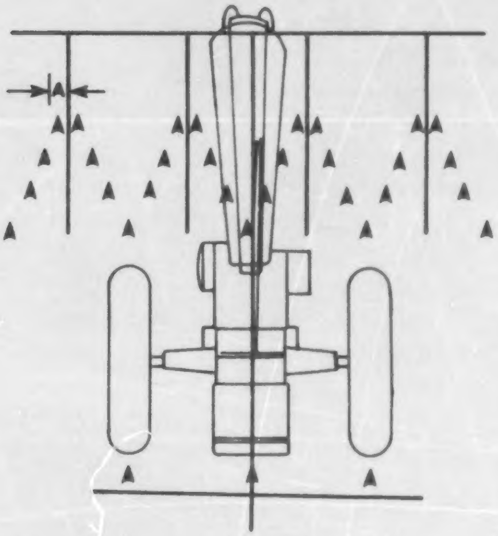

Tilt sweep
1/8- to 1/4-inch
Ground line

POINT TOO HIGH

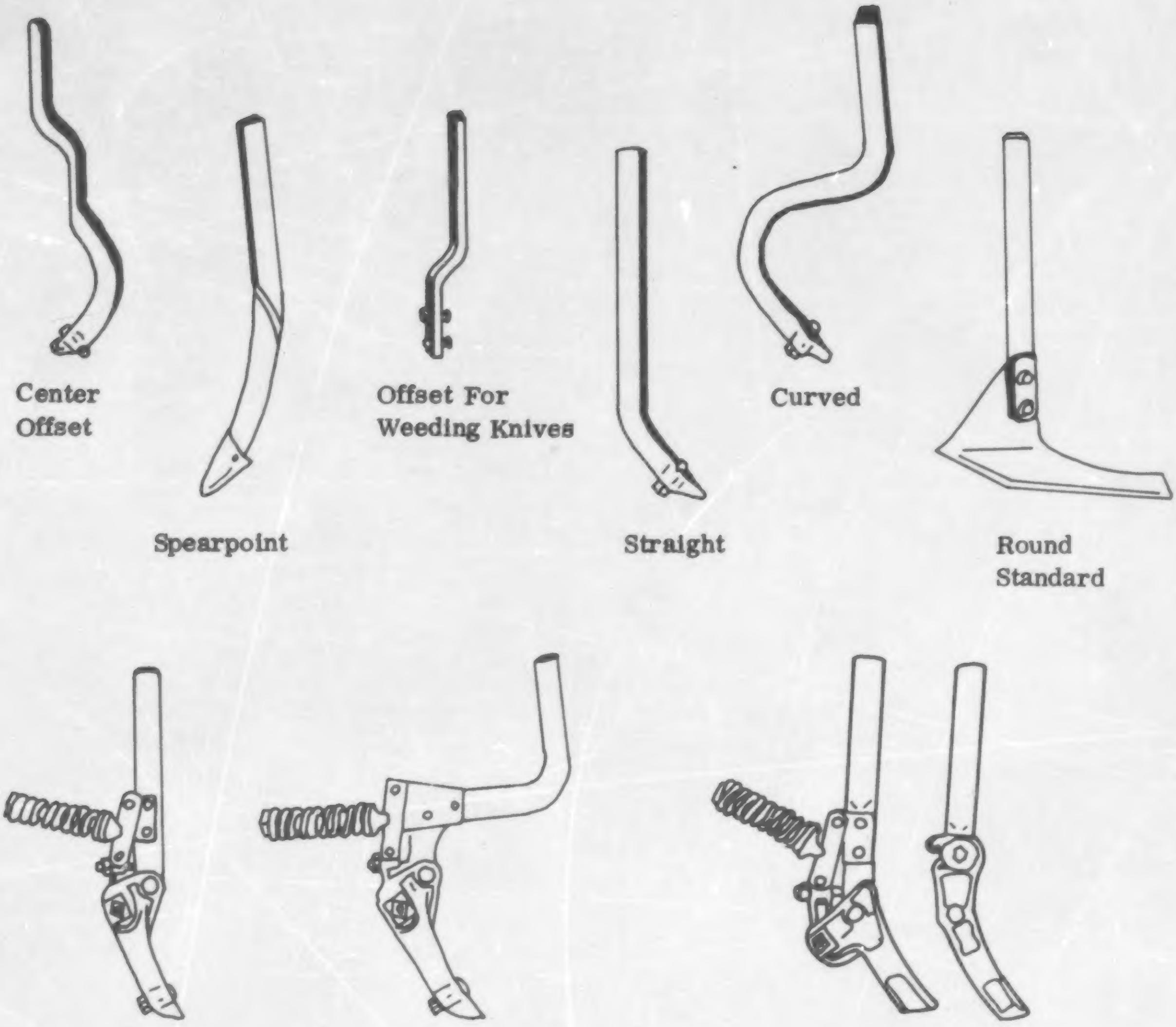
POINT TOO LOW

CORRECT SETTING

INCORRECT AND CORRECT SETTINGS FOR A CULTIVATOR SWEEP



A METHOD OF SETTING SWEEPS



Center Offset

Spearpoint

Offset For Weeding Knives

Straight

Curved

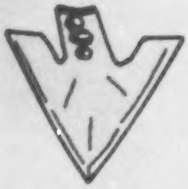
Round Standard

Straight Spring-Trip

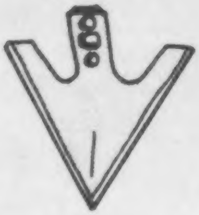
Curved Spring-Trip

Quick-Adjustable And Friction-Trip Shanks

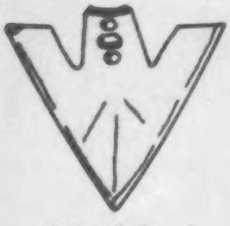
SPECIALIZED SHANKS



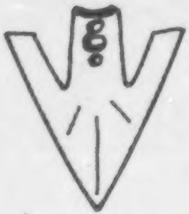
Universal



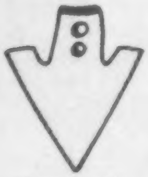
Peanut



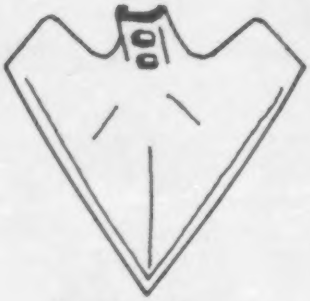
Mixed-land



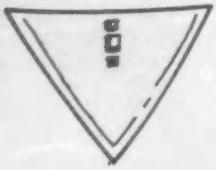
Backland



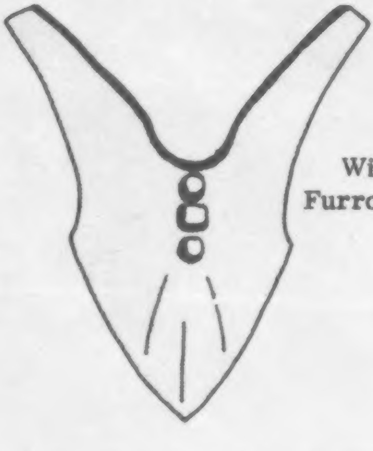
General Purpose



Duckfoot Sweep

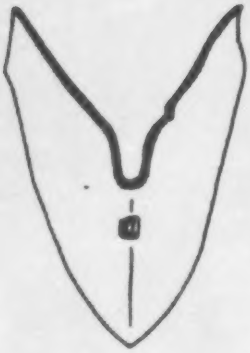


Triangular

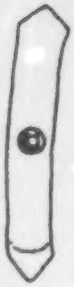


Winged Furrow-Opéner

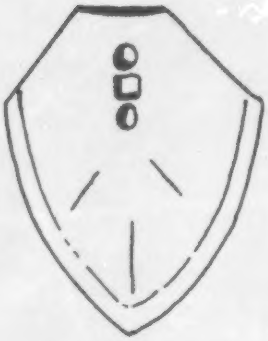
CULTIVATOR SWEEPS



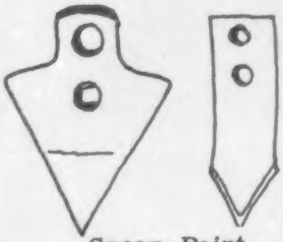
Irrigation Shovel



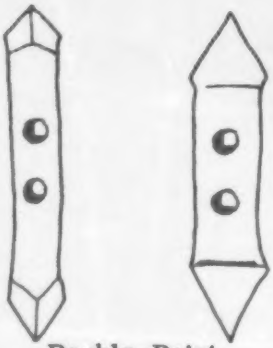
Diamond-Point Shovel



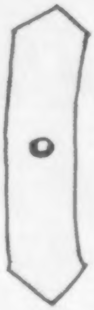
Opening Shovel



Spear-Point



Double-Point



Reversible, Oval

CULTIVATOR SHOVELS

Assignment Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Cultivating and Weed Control Equipment

TOPIC: Flame Weeders

OBJECTIVE: To develop an understanding of flame weed control and how it is accomplished.

REFERENCES:

1. Information Sheet, "Flame Weeders"
2. Farm Machinery and Equipment, pp. 226-228
3. Machines for Power Farming, pp. 335, 349

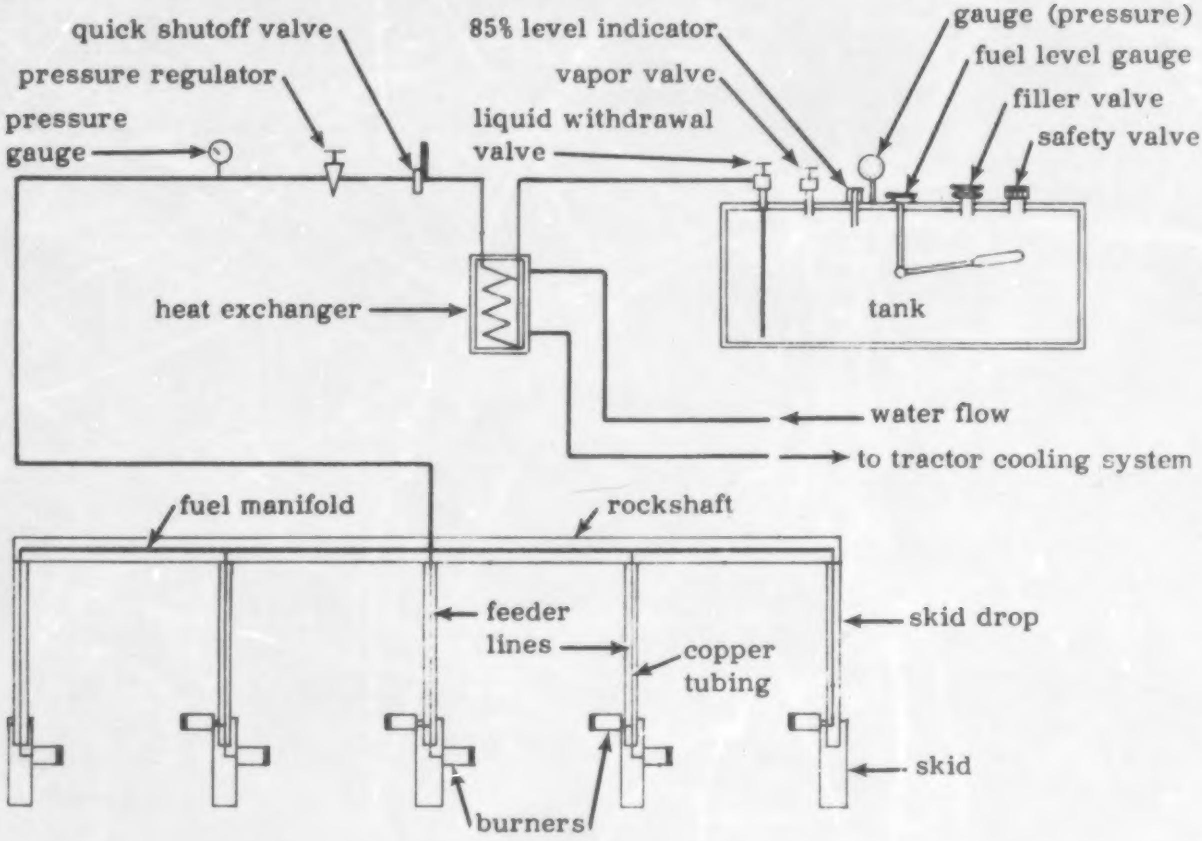
QUESTIONS OR ACTIVITIES:

1. List the equipment necessary for flame weed control.
2. List the number of burners required for a two-row system; a four-row system.
3. At what angle are the burners mounted?
4. How far from the plant should the flame be when it strikes ground?
5. The burner mouth should be how wide?
6. What type of fuel is used for flame weeders?
7. What is the pressure on the fuel line leading to the burners?

Information Sheet
on
FLAME WEEDERS

Fire has been used for many years by railroads to control weeds. Ranchers have used it to burn cactus for cattle to graze. The use of flame for weed control in row crops is a fairly new concept. The apparatus is mounted onto the tractor on cultivators or on an individual implement designed specially for it. It consists of a fuel tank, feed lines, control valves, fuel lines, and burners.

Burners are required for each side of the row; therefore, a two-row system requires four burners and a four-row system requires eight burners. The burners are mounted at an angle of 30 to 45 degrees to the horizontal. This directs the flame across and among the plants in the row. The flame should strike the ground about 2 inches from the plant. The burner mouth should be from 8 to 10 inches wide. Most burners, whether mounted on cultivators or on skids, are fueled with propane, butane, or a mixture of the two. This fuel is under pressure of 30 to 40 pounds in the lines leading to the burners.


quick shutoff valve
pressure regulator
pressure gauge
85% level indicator
vapor valve
liquid withdrawal valve
gauge (pressure)
fuel level gauge
filler valve
safety valve
heat exchanger
tank
water flow
to tractor cooling system
fuel manifold
rockshaft
feeder lines
copper tubing
skid drop
skid
burners

SCHEMATIC DIAGRAM OF A FLAME METHOD OF WEED CONTROL

Assignment Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Cultivating and Weed Control Equipment

TOPIC: Rotary Shredders

OBJECTIVE: To develop an understanding of the types, functions, parts, and specifications of other tillage equipment.

REFERENCES:

1. Information Sheet, "Rotary Shredders"
2. Machines for Power Farming, pp. 240-248
3. Farm Machinery and Equipment, pp. 411-417

QUESTIONS OR ACTIVITIES:

1. List the two types of rotary shredders.
2. Give the primary purpose of the rotary shredder.
3. Give the general specifications of a rotary shredder: width, weight, and size of tractor required to operate the shredder.
4. List the two different types of spindle cutters.
5. What are the three main types of cutting mechanisms used in shredders?
6. Explain how rotary cutters operate.
7. List the main parts of a rotary cutter.

Information Sheet
on
ROTARY SHREDDERS

Rotary shredders are a relatively new type of equipment. They were introduced commercially in 1945. They caught on quickly and became a very popular tool for cutting stalks and controlling weeds in pastures.

The rotary shredder cuts, shatters, feathers, tears, chops, mows, pulverizes, spreads, and mulches any foreign material so that it may be returned to the soil. Cutting and chopping is accomplished by revolving knives that rotate at a high rate of speed. The blades are attached to a spindle hub and operate on a horizontal plane. The blades may be either single piece or hinged two-piece and are driven by the power take-off. Some shredders operate on a vertical plane, perpendicular to the direction of travel. These are equipped with flails, hammers, or knives for cutting.

Rotary shredders may be either mounted or trailing. Trailing shredders usually have wheels and skids for transport and depth control. Mounted mowers usually have skids for depth control and are allowed to "float" by the hydraulic system.

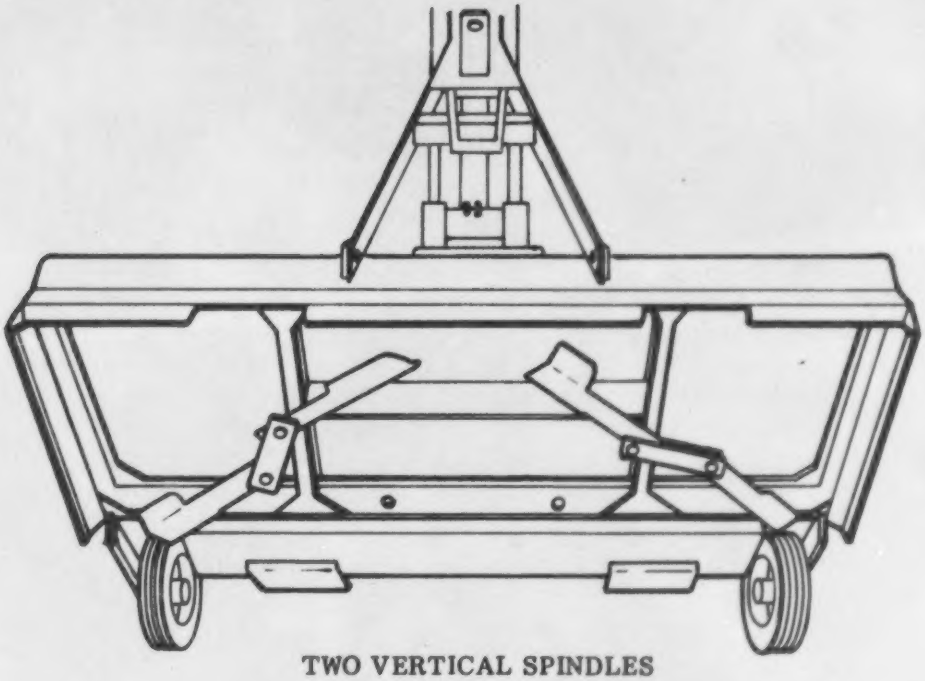
Rotary shredders come in all sizes to fit specific jobs. Widths range from 5 to 20 feet, and weights vary from 250 to 3200 pounds. Tractor horsepower required varies from 10 to 60 horsepower.

Shredders are available in vertical or horizontal shafts. Horizontal spindles or shafts make use of rubber flails, hammer and chain, or knives for cutting. The vertical spindle, which has become the most popular, uses blades for cutting.

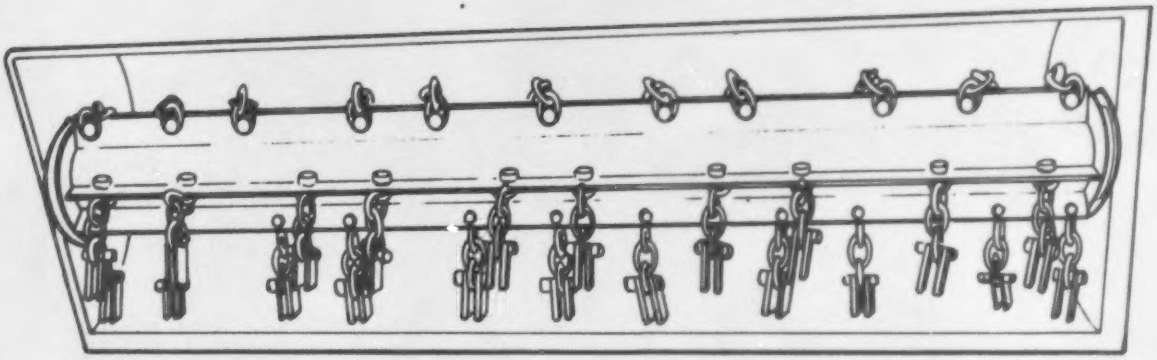
The main parts of a rotary cutter are:

1. Driving mechanism
2. Frame and cover
3. Blades
4. Gear box
5. Wheels

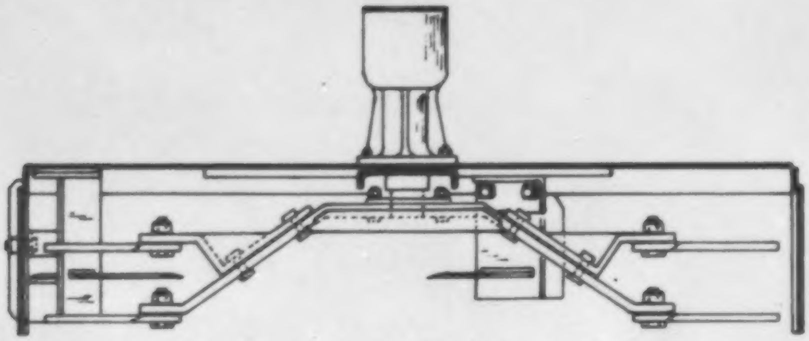
On vertical mowers the flail or knife cylinder is a major part.



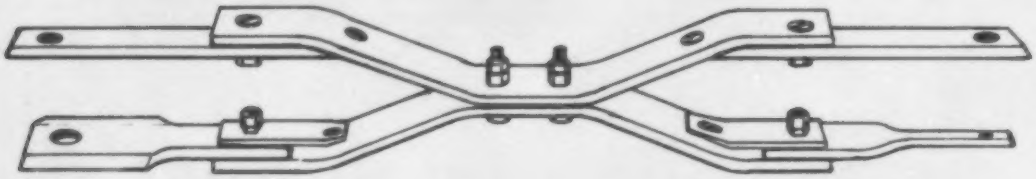
TWO VERTICAL SPINDLES
HORIZONTAL BLADES



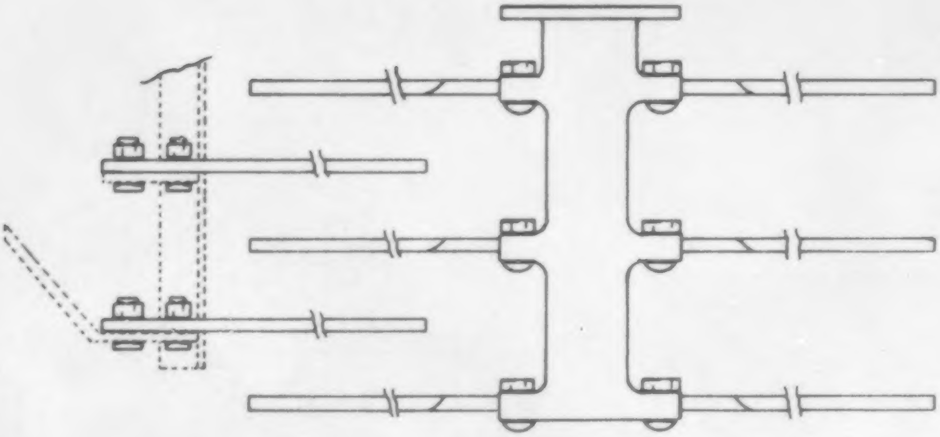
HORIZONTAL SPINDLE
VERTICAL BLADES



A ROTARY CUTTERHEAD WITH OFFSET BARS

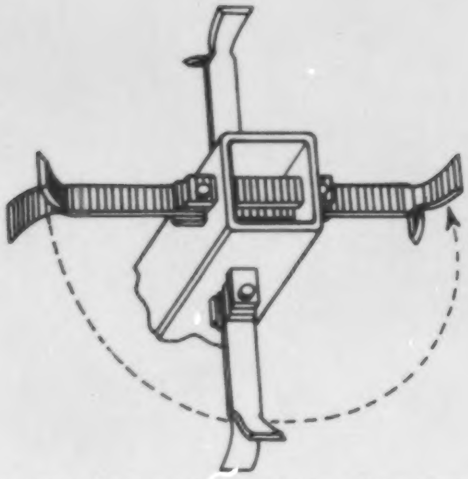


ROTARY CUTTER BARS FITTED WITH
STRAIGHT AND TWISTED CUTTER BLADES

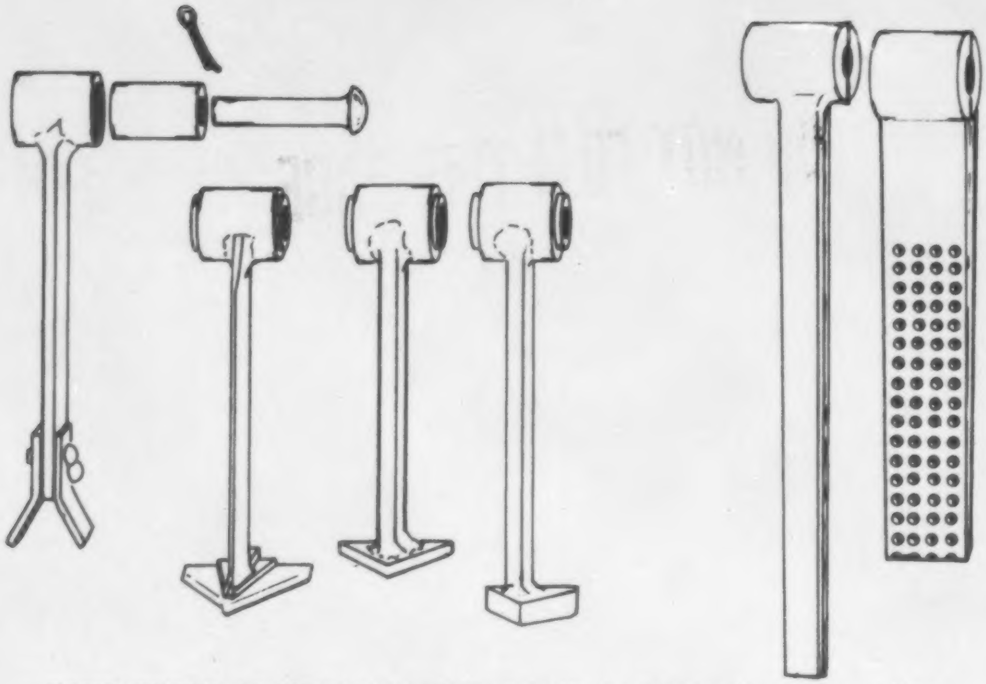


KNIFE HEAD FOR THREE ROTATING HORIZONTAL KNIVES

TYPES OF BLADES



V-SHAPED FLAIL STALK CUTTERS



FOUR TYPES OF METAL HAMMERS AND NARROW RUBBER FLAILS

Assignment Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Sprayers and Dusters

TOPIC: Hydraulic Sprayers -

OBJECTIVE: To develop an understanding of the types, functions, parts, and operation of hydraulic sprayers.

REFERENCES:

1. Information Sheet, "Hydraulic Sprayers"
2. Farm Machinery and Equipment, pp. 239-252
3. Machines for Power Farming, pp. 359-377

QUESTIONS OR ACTIVITIES:

1. List the essential parts of the typical hydraulic sprayer.
2. List the types of pumps most commonly used on hydraulic sprayers.
3. Name the three types of nozzles most commonly used.
4. List the factors which should be considered in the selection of the proper spray nozzle.
5. Sketch and label the parts of a power field sprayer as seen in information sheet.
6. List the most common types of spray patterns.
7. What is the meaning of hydraulic agitation?

Information Sheet
on
HYDRAULIC SPRAYERS

Sprayers are becoming more important on today's farms. As more chemicals are used to control weeds, insects, and disease, sprayers will play an ever increasing role in modern agriculture.

The most important part of any sprayer is the pump. Since both sprayer pressure and volume depend on the pump it must be matched to the job. There are three types of pumps found on agricultural sprayers:

1. Reciprocating pumps - these are high pressure pumps that put out a pulsating spray when not equipped with an air dome.
2. Rotary pumps - these are smooth operating and are probably the most popular type for agricultural applications. There are several of these types of pumps:
    a. External gear
    b. Internal gear
    c. Flexible impeller
    d. Roller impeller
    e. Sliding vane
3. Diaphragm pumps - these are not often used on agricultural sprayers but are excellent for pumping dirty liquids.

Most hydraulic sprayers are equipped with positive displacement pumps.

Another important part of the sprayer is the nozzle. This is the part of the sprayer that breaks the liquid into the proper size to be applied to the plants. Since no one nozzle can meet the requirements for all situations, these are made interchangeable. The three main types of nozzles are:

1. Fan pattern - distributes the liquid in an even fan-type pattern, popular for weed sprayers.
2. Hollow cone - gives a circular pattern.
3. Solid cone - gives a complete round pattern.

When selecting the proper nozzle these things should be considered:

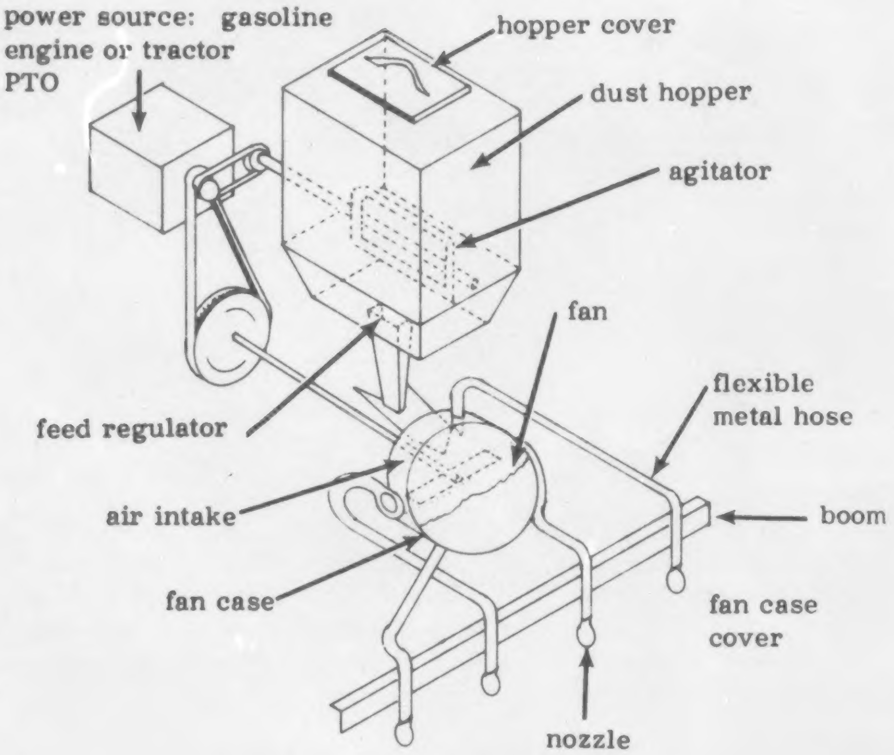
1. Type of job
2. Row spacing and the number of nozzles per row
3. Amount of spray solution applied per acre
4. Nozzle spacing when complete coverage is desired
5. Type of spray pattern
6. Speed of travel
7. Pressure to be used

Hydraulic Sprayers
(Information Sheet continued)

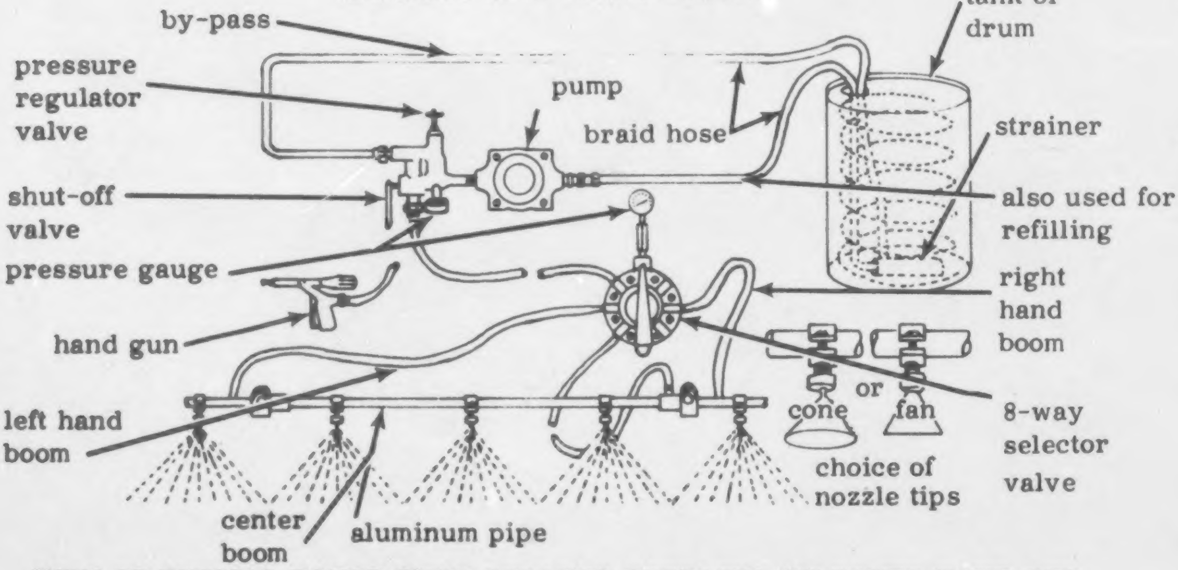
Sprayer components vary with sprayer types. Some common parts are:

1. Pump
2. Tank containing an agitator
3. Framework
4. Pressure gauge
5. Strainers
6. Pressure regulator and relief valve
7. Screen
8. Control valves
9. Piping and fittings
10. Distribution system
11. Power source

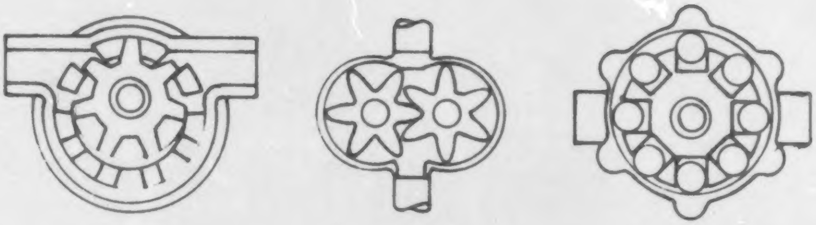
Hydraulic spraying systems must keep the particles of the solution in suspension. This may be accomplished in either of two ways. Hydraulic agitation diverts some of the pressure from the pump back into the tank to keep it stirred up. Mechanical agitation operates off the engine and does a better job.


power source: gasoline engine or tractor PTO
hopper cover
dust hopper
agitator
fan
flexible metal hose
feed regulator
air intake
boom
fan case
fan case cover
nozzle

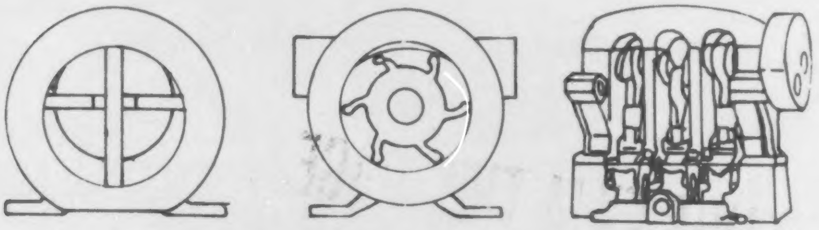
DRAWING OF A POWER DUSTER


by-pass
tank or drum
pressure regulator valve
pump
braid hose
strainer
shut-off valve
also used for refilling
pressure gauge
right hand boom
hand gun
cone
or
fan
8-way selector valve
left hand boom
choice of nozzle tips
center boom
aluminum pipe

VIEW OF TYPICAL POWER FIELD SPRAYER OPERATED BY POWER TAKE-OFF

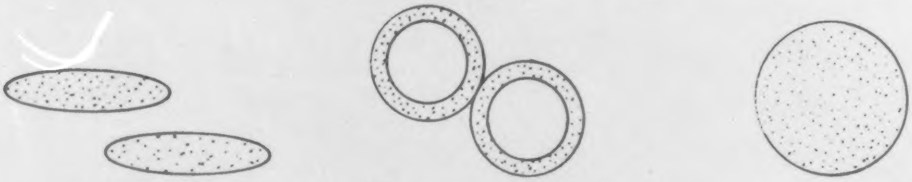


internal gear pump external gear pump rotor-type pump



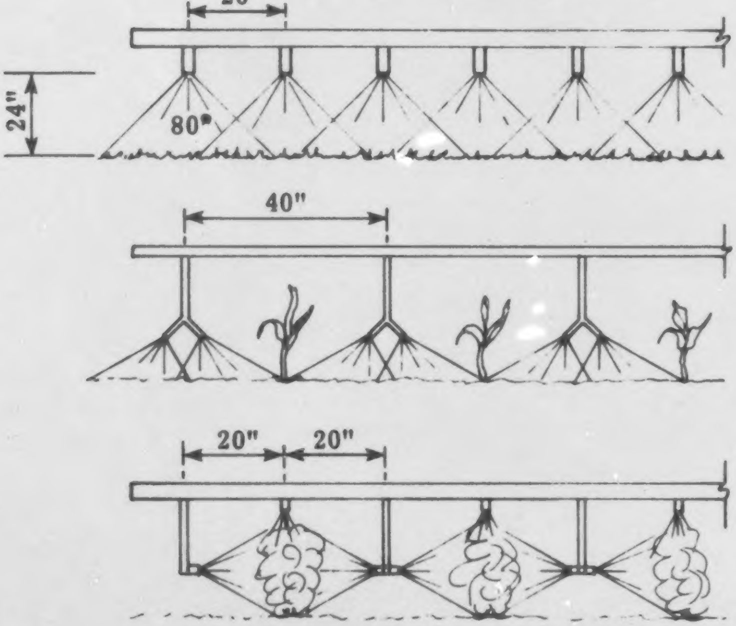
vane-type pump impeller-type pump piston-type pump

TYPES OF SPRAYER PUMPS



FAN TYPE HOLLOW-CONE TYPE SOLID-CONE TYPE

SPRAY PATTERNS



WEEDS AND INSECTS

BETWEEN ROWS FOR WEED CONTROL

OVER AND BETWEEN ROWS FOR INSECT CONTROL

METHODS OF ARRANGING NOZZLES ON BOOM

Assignment Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Sprayers and Dusters

TOPIC: Pumps for Agriculture Sprayers

OBJECTIVE: To develop an understanding of the parts of a sprayer pump and how they operate and to learn the different types of pumps available.

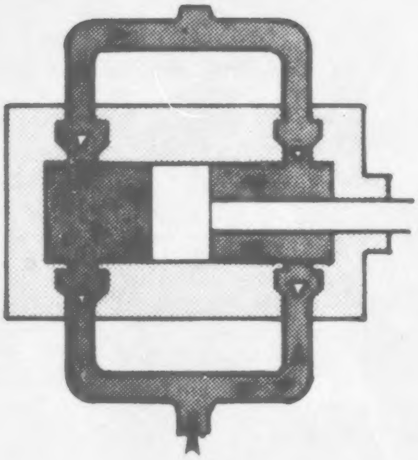
REFERENCES:

1. Machines for Power Farming, pp. 360-363
2. Information Sheet, "Pumps for Agriculture Sprayers"

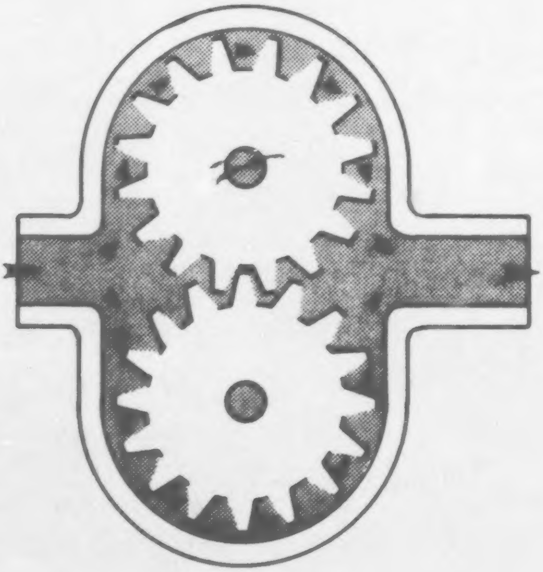
QUESTIONS OR ACTIVITIES:

1. List the six types of pumps for agriculture sprayers.
2. List the six types in the order of initial cost (lowest to highest cost).
3. Give the adaptability of the six types of pumps.
4. Draw a sketch of each type of pump and identify each.
5. Explain how the impeller rotary pump functions.
6. What type of pump is used on low pressure sprayers and why?

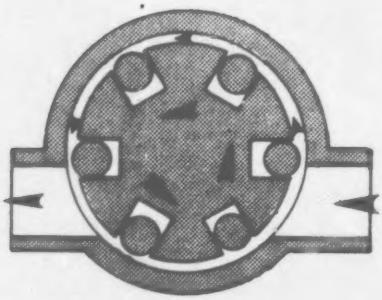
Information Sheet
on
PUMPS FOR AGRICULTURE SPRAYERS



The piston pump is a displacement type pump that can develop high pressures. Although the most expensive type of pump, it can be used for many different jobs. Piston pumps can apply both corrosive and abrasive materials. These pumps have a stainless steel piston with a leather, rubber, or plastic packing gland. In the more expensive and durable pumps, the cylinder wall may be lined with or may be entirely of ceramic materials. The less expensive piston pumps are constructed principally of steel. Generally they are constructed with replaceable liners for easy and economical servicing.



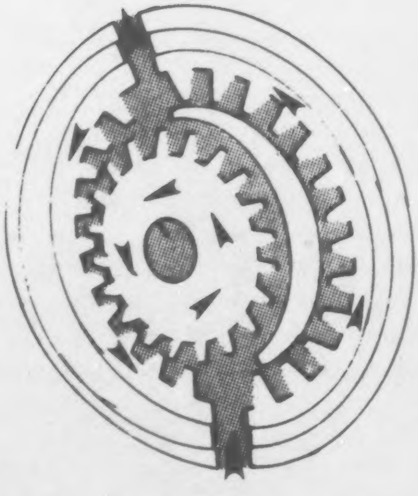
The gear pump is a type of pump that can develop moderate pressures. It will maintain a uniform pressure and volume, but the volume is limited. In the gear pump, liquid is pulled in where the rotating gears separate and is pushed out on the opposite side as they roll together. These gears are the principal parts of the pump and take all the wear, so this pump is not adapted to abrasive materials. It is well suited to pumping oil suspensions or emulsions at low volumes and pressures. The gears and housing are generally made of bronze and the gear shafts of stainless steel. It is a compact unit that is easy to mount to a power source such as the power take-off of a tractor.



The roller impeller pump is probably the most widely used pump in agriculture today. It is adaptable to a wide range of pressures, volumes, materials, and situations.

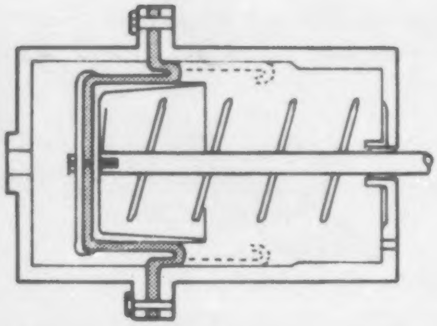
The pumping action of the roller impeller pump is created by the roller following the eccentric housing, going out of the slots to take on liquid and being compressed back into the slots to force the liquid out. The pump can move a high volume of liquid at a reasonably high pressure. It maintains a constant pressure and flow, making it possible for more accuracy in controlling the amount and placement of spray material.

This pump can be adapted to handle a wide range of chemicals. Nylon covered rollers usually are used with a cast nickel-iron alloy housing to handle the non-abrasives. Rubber covered rollers are used for the more abrasive type materials such as wettable powders. The roller pump is a compact unit that can be mounted easily to available power sources.



The characteristics of the internal gear pump are almost identical to the gear pump. This pump's design gives more compactness than the gear pump. Pumping action is created when the larger gear is rotated by a power source, and it in turn rotates the small idler gear. The gear teeth separate and pull material in on one side and push it out as they mesh again at the outlet part of the pump. Usually the housing is cast or iron or nickel-iron alloy and is designed to attach directly to the power take-off of the tractor.

**Pumps for Agriculture Sprayers
(Information Sheet continued)**

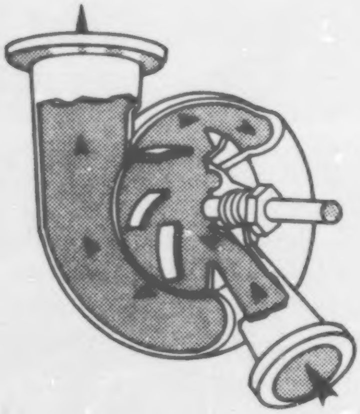


The pumping action of a diaphragm pump is caused by the movement of the diaphragms. This pump may be constructed with either one or two diaphragms. The most popular is a single diaphragm because of its lower cost. Liquid is drawn into the chamber by the downward stroke and is forced out by the upward stroke.

Chief limitations of this pump are pulsating pressures and the relatively small volume capacity. Stroke pulsations are evened out by small air chambers in the pump head. Also, two diaphragms help minimize these pulsations and give a greater volume.

The valves, usually made of neoprene, are spring loaded. The diaphragms usually are made of combined materials that will best resist the expected action of chemicals to be pumped.

This pump can handle a wide range of chemicals, including abrasive and coarse material. It will operate for a long time if the material in the diaphragm is not deteriorated by the chemical being pumped and if the bearings are of the roller type.



A centrifugal pump handles coarse or abrasive materials effectively. Pumping action is created by a high speed impeller that literally throws material out of the pump. This high speed limits its use on tractors for applying agricultural chemicals. Specially designed power take-off units are available that increase impeller speed for applying agricultural spray materials. This type of pump is used most frequently as a water pump for high volumes and low pressures. Pressure and pumping capacity decrease with wear and roughness of impeller and housing. This pump requires priming unless located below the level of the supply tank.

Assignment Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Sprayers and Dusters

TOPIC: Blower Sprayers

OBJECTIVE: To develop an understanding of the blower sprayers, their use, and their operation.

REFERENCES:

1. Farm Machinery and Equipment, pp. 252-254
2. Information Sheet, "Blower Sprayers"

QUESTIONS OR ACTIVITIES:

1. On what kind of crops are blower sprayers generally used?
2. What carries the chemical from the blower to the crop?
3. What type of pump is generally used on a blower sprayer?
4. Why is accuracy so important when working with the blower sprayer?
5. Why is the sprayer speed so important when using a blower sprayer?
6. How does a fog machine operate?

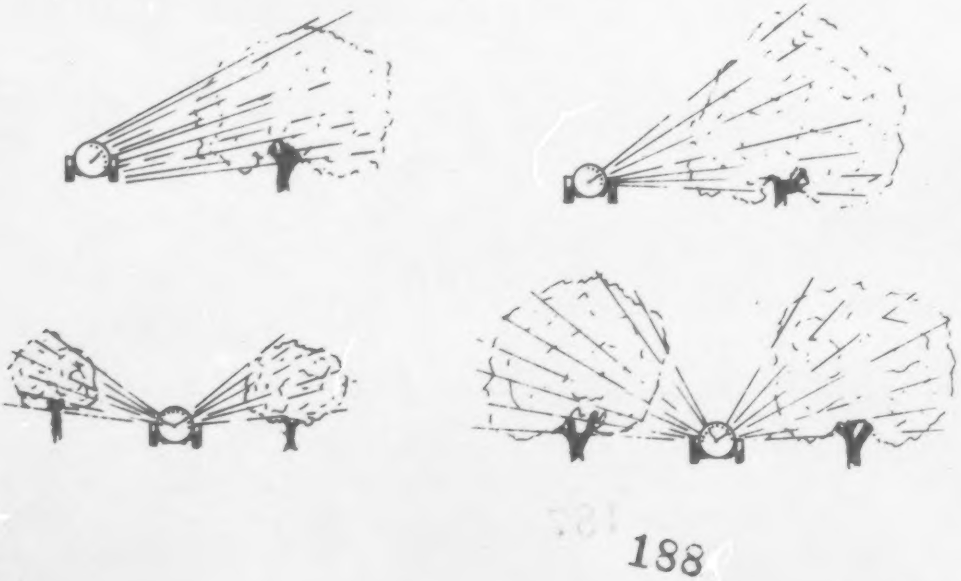
Information Sheet
on
BLOWER SPRAYERS

Blower sprayers are a relatively new piece of equipment and are similar to power dusters. These were developed to apply chemicals in a concentrated form where the amount of water needed is cut from 20 to 80 percent. These blowers were designed for large acreages of fruit trees, large shade trees, and vegetables. Unlike other sprayers, where the chemical is carried in water, here air is used as the transport medium. The pump requirement for this sprayer is fairly small. It utilizes a low pressure, low volume pump.

Using this type of sprayer requires careful operation. Due to the concentrated state of the spray, slight carelessness in operation could greatly affect the results. As the sprayer operates it must be pulled at an exact speed. Pulling too fast could cause under-dosing, and the maximum effect of the chemical would not be achieved. If the sprayer were pulled too slowly, some of the chemical would be wasted due to over-dosing which could even damage the plants. Sprayers of this type are usually automatic, and only the tractor driver is needed.

Another machine similar to the blower sprayer is the fogger. Here again the chemical is dispersed into fine particles that are carried in the air. However, the droplets are much smaller, 1-50 microns, and therefore stay airborne much longer. This spray usually has little residual effect; therefore, it must come into immediate contact with the pest to be controlled if it is to be effective. It is most often used to control mosquitos, flies, and other small insects.

FOUR SPRAY PATTERNS THAT CAN BE DELIVERED BY BLOWER SPRAYERS



Assignment Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Sprayers and Dusters

TOPIC: Dusters

OBJECTIVE: To develop an understanding of the types of dusters, how they operate, and where they are to be used.

REFERENCES:

1. Machines for Power Farming, pp. 377-378
2. Farm Machinery and Equipment, pp. 262-267
3. Information Sheet, "Dusters"

QUESTIONS AND ACTIVITIES:

1. What are the five primary parts of a duster?
2. List the two general types of dusters.
3. Compare aircraft application with ground application in your community.
4. What is the advantage of dusting over spraying?
5. What is the advantage of spray over a dust with aircraft application?
6. Describe the function of a mist sprayer.

Information Sheet
on
DUSTERS

There are many types of ground dusters available, but only recently have noticeable improvements been made in them. Most have been built on the row-crop principle with a distributor head at the hopper and hoses radiating to nozzles and boom. This type has from six to eighteen nozzles and may cover up to 25 feet. A fan picks up the dust at the hopper and sends it out to the nozzles. The nozzles are of many types but all work on the same principle. The outlets are placed as near the crop as possible to prevent drift. Sometimes a canopy or canvas may be attached to the boom to reduce drift, but this is not completely effective. In another type, the insecticide is delivered through a single or double tube, and the dust is allowed to drift over the crop. This is sometimes termed "drift-dusting." This method does not do a very good job, is wasteful of insecticides, and creates severe drift problems. One of the newer types is the "Hardie Duster," which uses a vertical auger for delivery. The dust is blown along a tapering boom which has outlets every ten inches. This is a very effective duster for field and vegetables crops. The first and last types mentioned are the most practical for field and vegetable crop pest control. For a multipurpose duster, the latter is probably the more practical.

SPRAYS vs DUSTS:

The debate as to the relative effectiveness of sprays and dusts is one that will go on indefinitely. Each is good, and each can do certain jobs that the other cannot. There are many problems where either material, if properly applied, will do a satisfactory job. There are some cases in which certain pests are much more susceptible to one form of the toxicant than to another. Frequently, the sprays are more toxic to the insects than are the dusts, and in some cases the sprays cannot give the coverage obtainable with the dusts. These facts tend to balance one another in this picture. However, on many of the common problems, it is being found that concentrated low dosages of sprays will give better insect control and a longer residual action than the dusts. Some of the reasons for this probably are:

1. The spray itself is more toxic than the dust. (It is more concentrated.)
2. A greater amount of the material is put on a given area.
3. The concentrated droplets do not weather or break down as readily as the more dilute dusts.
4. The dust particles frequently fall or are knocked off the plant by wind, rain, or insect activity, and thus the residual effect is lost.

Dusters
(Information Sheet continued)

5. The spray droplets containing the particles of toxicant stick closely to the plant or leaf surface and are not easily dislodged; this increases the residual effect.

In a general statement (but not concerning specific problems), the farmer gets more for his money from airplane sprays than from dusts. Also, of considerable importance in this discussion is the amount of drift. Sprays drift considerably less than dusts; this not only keeps more of the insecticide in the confines of the field, it also reduces the hazard of allowing a poisonous material to kill out an adjoining bee population or to cause trouble by drifting into an inhabited area to get onto feed or fodder that is being fed to livestock.

Advantages of spraying over dusting:

1. Dusts should not be applied in winds over 3 m.p.h. Sprays can be applied in winds up to 10 m.p.h. and even higher in some cases.
2. Spray can be applied later in the morning and earlier in the evening. Certain crops can be sprayed all day long.
3. The size of the droplets can be changed to fit the conditions of application and the problem.
4. Drift hazards are usually less with sprays, and less toxicant per acre is usually required.
5. Sprays are usually cheaper than dusts.
6. In many cases, sprays give better control than dusts.
7. A higher rate of deposit of the toxicant is obtained with sprays, and they usually have a longer residual effect.
8. Flagmen are more essential with sprays, which usually results in a better application.

Advantages of dusting over spraying:

1. Simpler
2. Equipment and dust are lighter
3. Lower initial cost
4. Less corrosion

Duster components vary with the type, but most have these basic parts:

1. Hopper
2. Agitator
3. Blower
4. Duct
5. Spout delivery system

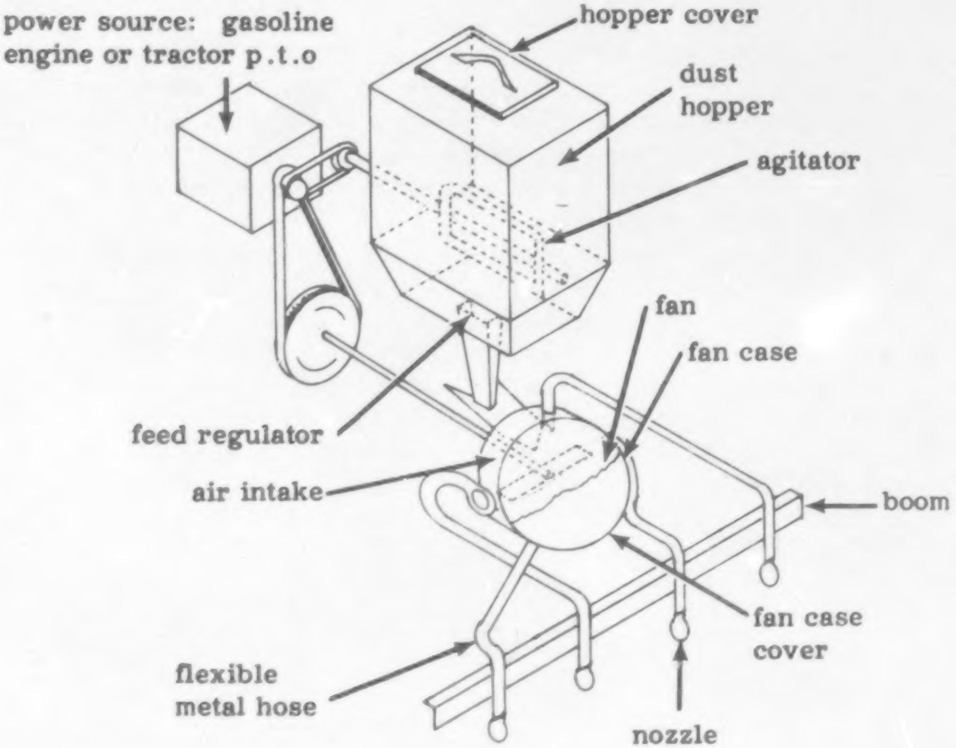
Dusters
(Information Sheet continued)

Dusters come in two types:

1. Field type
2. Orchard power duster

Other equipment that is similar to this is the mist sprayer which is used mainly to spray trees. It is sometimes called a fog sprayer, because the mist is usually placed where it will drift with the wind. An orchard mist sprayer has several nozzles fixed in a pipe manifold. An air stream is forced through the manifold to force the material out.

SCHEMATIC DRAWING OF TYPICAL POWER DUSTER


power source: gasoline engine or tractor p.t.o
hopper cover
dust hopper
agitator
fan
fan case
feed regulator
air intake
boom
fan case cover
flexible metal hose
nozzle

* * * * * * * * *

Material for this Information Sheet was taken from "Application of Insecticides," Agricultural Extension Service, University of Wyoming.

Assignment Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Sprayers and Dusters

TOPIC: Calibrating Spray Equipment

OBJECTIVE: To develop an understanding of the importance of calibrating spray equipment. To understand how to determine ground speed, gallonage output per acre, nozzle capacity (or gallons per minute), boom length, and pump output in gallons per minute.

REFERENCE:
Information Sheet, "Calibrating Spray Equipment"

QUESTIONS OR ACTIVITIES:

Solve the following problems:

1. Example - No. 1 in Information Sheet

$$\text{mph} = \frac{495 \times \text{gpm per nozzle}}{\text{nozzle spacing (ft.)} \times \text{gpa}}$$

495 is constant.
How fast should the sprayer travel if each nozzle delivers 0.050 gallons per minute, with nozzle spacing 15" (1.25') and 4 gallons per acre as the desired quantity of spray?

2. Example - No. 2 in Information Sheet

$$\text{gpa} = \frac{495 \times \text{gpm per nozzle}}{\text{nozzle spacing (ft.)} \times \text{speed (mph)}}$$

How many gallons per acre will be sprayed if each nozzle delivers 0.555 gallons per minute, with a nozzle spacing of 12" (1') and a desired ground speed of 5 mph?

3. Example - No. 3 in Information Sheet

$$\text{nozzle capacity (gpm)} = \frac{\text{gpa} \times \text{speed (mph)} \times \text{nozzle spacing (in.)}}{5940}$$

5940 is constant.
The pesticide is to be applied at a rate of 25 gallons per acre (gpa); the nozzle spacing on the boom is 15", and the sprayer will travel at 7 mph. What capacity nozzle (in gpm) is required?

UNIT: Sprayers and Dusters
TOPIC: Calibrating Spray Equipment
(Assignment Sheet continued)

4. Example - No. 4 in Information Sheet

$$\text{length boom (ft.)} = \frac{43560 \text{ X acres to be sprayed}}{\text{\% time spent spraying X \# working hrs. X } 5280 \text{ X speed (mph)}}$$

What length of boom is required on a sprayer operating at 6 mph to permit spraying of a 70 acre field in 8 working hours? (75% of time spent in actual spraying, 25% in filling tank, turning, etc.)

5. Example - No. 5 in Information Sheet

$$\text{pump output in gpm} = \frac{5280 \text{ X mph X boom length X gpa}}{60 \text{ X } 43560}$$

What minimum size pump is required to apply a spray at 9 gallons per acre with a sprayer operated at 5 mph and equipped with a boom 20 feet long?

Information Sheet
on
CALIBRATING SPRAY EQUIPMENT

1. For determination of ground speed where a certain gallonage per acre is desired and ground speed can be varied:

$$\text{mph} = \frac{495 \times \text{gpm per nozzle}}{\text{nozzle spacing (ft.)} \times \text{gpa}}$$

495 is constant.

Example: How fast should the sprayer travel if each nozzle delivers 0.067 gallons per minute, with nozzle spacing of 20" (1.67') and 5 gallons per acre as the desired quantity of spray?

$$\text{mph} = \frac{495 \times 0.067}{1.67 \times 5} = \frac{33.17}{8.35} = 3.98 \text{ or } 4 \text{ mph}$$

2. For determination of gallonage output per acre where ground speed is constant and gallons per acre can be varied:

$$\text{gpa} = \frac{495 \times \text{gpm per nozzle}}{\text{nozzle spacing (ft.)} \times \text{speed (mph)}}$$

Example: How many gallons per acre will be sprayed if each nozzle delivers 0.067 gallons per minute, with a nozzle spacing of 20" (1.67') and a desired ground speed of 4 mph?

$$\text{gpa} = \frac{495 \times 0.067}{1.67 \times 4} = \frac{33.17}{6.68} = 4.98 \text{ or } 5 \text{ gpa}$$

3. For determination of nozzle capacity (gpm) required:

$$\text{gpm} = \frac{\text{gpa} \times \text{speed (mph)} \times \text{nozzle spacing (in.)}}{5940}$$

5940 is constant.

Example: Pesticide is to applied at a rate of 20 gallons per acre (gpa); the nozzle spacing on the boom is 20", and the sprayer will travel at 5 mph. What capacity nozzle (in gpm) is required?

$$\text{gpm} = \frac{20 \times 5 \times 20}{5940} = 0.34 \text{ gpm}$$

Consult nozzle manufacturer specifications for selection of proper nozzle. There is a definite relationship among various factors such as ground speed, pump capacity, nozzle size, length of boom, and pressure. These are demonstrated in the following examples.

Calibrating Spray Equipment
(Information Sheet continued)

4. For determination of boom length:

$$\text{boom length (ft.)} = \frac{43560 \text{ X acres to be sprayed}}{\text{\% time spraying X \# working hrs. X 5280 X speed (mph)}}$$

Example: What length of boom is required on a sprayer operating at 5 mph to permit spraying an 80 acre field in 8 working hours? (70% of time spent in actual spraying; 30% in filling tank, turning, etc.)

$$\text{boom length} = \frac{43560 \text{ X } 80}{0.7 \text{ X } 8 \text{ X } 5280 \text{ X } 5} = 236' \text{ (use closest standard size boom)}$$

According to a general rule of thumb, at 5 mph for 3 working days, each foot of boom length will cover approximately 10 acres. Thus, a 250 acre field could be covered in 3 days at 5 mph with a 25' boom.

5. For determination of pump output in gpm:

gpm = sq. ft. per minute to be covered X gallons per sq. ft. to be applied

$$\text{gpm} = \frac{5280 \text{ X mph X boom length X gpa}}{60 \text{ X } 43560}$$

Example: (1) What minimum size pump is required to apply a spray at 10 gallons per acre with a sprayer operated at 5 mph and equipped with a boom 25' long? (Pump capacity must be great enough to accommodate by-pass agitation unless mechanical agitation is to be provided.)

$$\text{pump output (gpm)} = \frac{5280 \text{ X } 5 \text{ X } 25 \text{ X } 10}{60 \text{ X } 43560}$$

pump output (gpm) = 2.5

(2) What is the maximum rate of application in gpa of a sprayer equipped with a 7 gpm pump and a boom 20' long when operated at 5 mph, assuming 20% loss to by-pass agitation? From the above relationship we have:

$$\text{gpa} = \frac{\text{pump output in gpm}}{\text{acres covered per minute}}$$

$$\text{gpa} = \frac{\text{gpm X } 60 \text{ X } 43560}{5280 \text{ X speed (mph) X boom length}}$$

$$\text{gpa} = \frac{5.6 \text{ X } 60 \text{ X } 43560}{5280 \text{ X } 5 \text{ X } 20}$$

gpa = 27

To apply the spray material at a high rate with this sprayer, either:

a. Reduce the ground speed
b. Space nozzles closer
c. Increase pressure
d. Increase nozzle size

Calibrating Spray Equipment
(Information Sheet continued)

Nozzle discharge does not vary linearly with pressure, but varies with the square root of pressure. For this reason, it is not advisable to try to increase spray rate of herbicides by raising pressure; drift is increased greatly, but there is little effect on rate. For example, if it is necessary to raise the pressure from 20 psi to 80 psi to double the spray rate, the higher pressure might give excessive drift.

$$\text{output per nozzle (gpm)} = \frac{\text{pump output in gpm}}{\text{\# of nozzles}}$$

$$\text{output per nozzle (gpm)} = \frac{\text{pump output X nozzle spacing}}{\text{boom length}}$$

$$\text{output per nozzle (gpm)} = \frac{\text{gpa X mph X 5280 X nozzle spacing (in.)}}{\text{43560 X 60 X 12}}$$

Example: What capacity nozzle should be used for an application of 20 gallons per acre with the sprayer traveling at 5 mph and the nozzles spaced 20" apart on the boom?

$$\text{gpm} = \frac{20 \text{ X } 5 \text{ X } 5280 \text{ X } 20}{43560 \text{ X } 60 \text{ X } 12}$$

$$\text{gpm} = 0.337$$

ABBREVIATIONS AND CONSTANTS

ft. = feet
gpa = gallons per acre
gpm = gallons per minute
lb/A = pounds per acre
mph = miles per hour
rpm = revolutions per minute
psi = pressure, pounds per square inch

sq. ft. = square feet
gal. = gallon(s)
495 = conversion factor or constant
5940 = conversion factor or constant
1 acre = 43,560 square feet
1 mile = 5,280 feet
1 mph = 88 feet per minute

* * * * * * * *

Material for this Information Sheet was taken from "Calibration of Pesticide Application," Circular 275A, Agricultural Extension Service, Institute of Food and Agricultural Sciences, University of Florida, Gainesville, FL.

Assignment Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Fertilizers

TOPIC: Manure Spreaders

OBJECTIVE: To develop an understanding of the types of manure spreaders and to understand the different parts of a manure spreader and how these parts operate.

REFERENCES:

1. Farm Machinery and Equipment, pp. 269-275
2. Machines for Power Farming, pp. 266-279
3. Information Sheet, "Manure Spreaders"

QUESTIONS OR ACTIVITIES:

1. List the two types of manure spreaders used on farms today.
2. Name five major parts of a manure spreader.
3. What are some of the factors which would determine what size spreader to purchase?
4. What are the four types of chains used on manure spreaders?
5. How is the capacity of a manure spreader expressed? What sizes are available?
6. Explain the function of the conveying system.
7. Why is the spreader box on most spreaders wider at the rear than at the front?

Information Sheet
on
MANURE SPREADERS

Manure spreaders are important pieces of equipment where livestock are raised. When buying a spreader these factors should be considered:

1. Number of animals - larger numbers of animals require larger machines.
2. Hauling distance - larger spreaders mean fewer trips to the field.
3. Hilly conditions - some larger machines may be top-heavy for some conditions.
4. Traction - If the soil has exceptionally poor traction characteristics a wheel driven spreader would not work.
5. Soil softness - larger machines may be too heavy for softer soils.

Manure spreaders are either power take-off driven or wheel driven. Either type is acceptable depending on the local situation, although the PTO driven spreaders may have an advantage.

Spreader components vary with the different types, but some parts common to both types are:

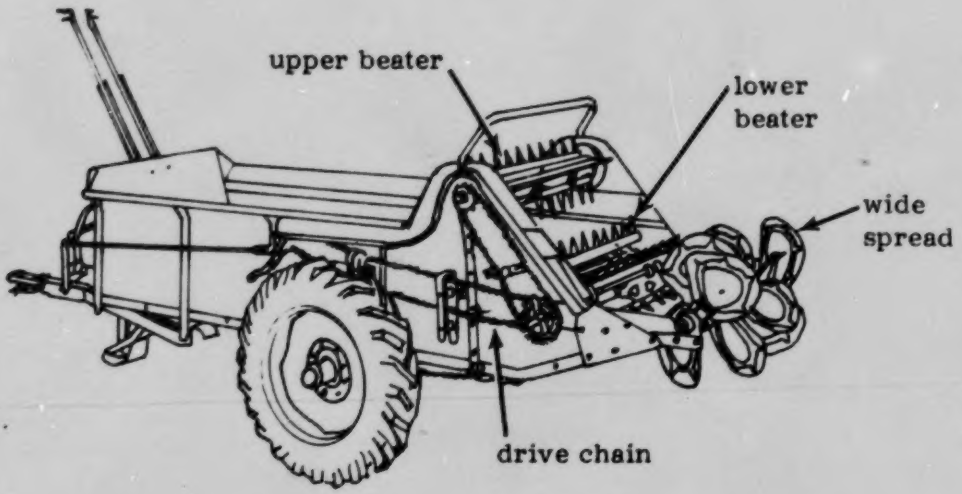
1. Frame
2. Conveyor
3. Box
4. Beater
5. Widespread

Manure boxes vary in size, with the capacities ranging from 45 to 175 bushels.

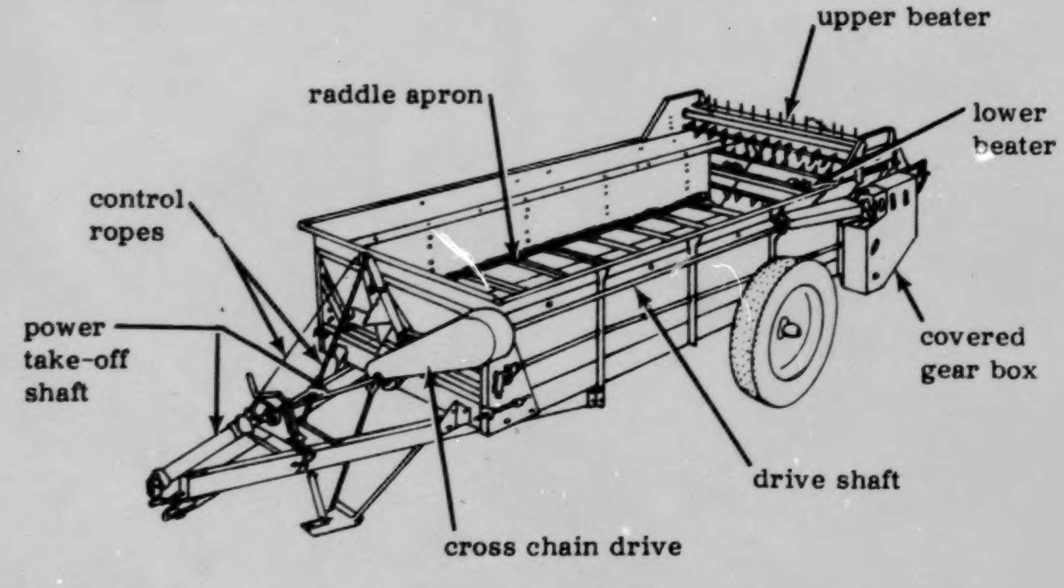
For the manure to be removed from the machine it must be conveyed backward. The conveyor, also called an apron, moves the manure to the rear of the machine. This conveyor consists of chains, slats, axles, and sprockets. Nearly all spreader boxes are from 1 to 2 inches wider at the rear than at the front. This prevents packing of the manure as it is forced backward. When the manure reaches the rear, it comes in contact with the beaters. Here it is shredded and prepared for deposit on the soil. It is then passed on back to the widespread where it is thrown out.

Spreader parts are operated either by gears or chains and spockets. If chains are used, the roller chains are the best. These resist wear and also wear the sprocket less. There are four basic types of chains used on spreaders, which are listed below. The first two are examples of roller chains.

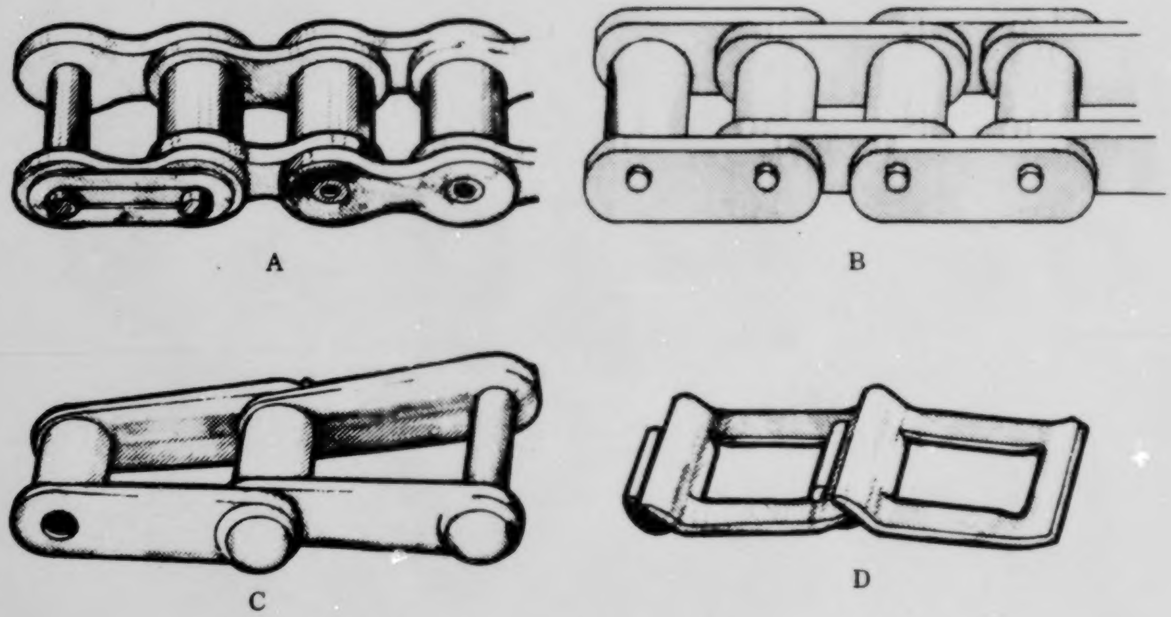
A. Regular-pitch roller chain
B. Double-pitch roller chain
C. Pintle chain
D. Detachable link chain


upper beater
lower beater
wide spread
drive chain

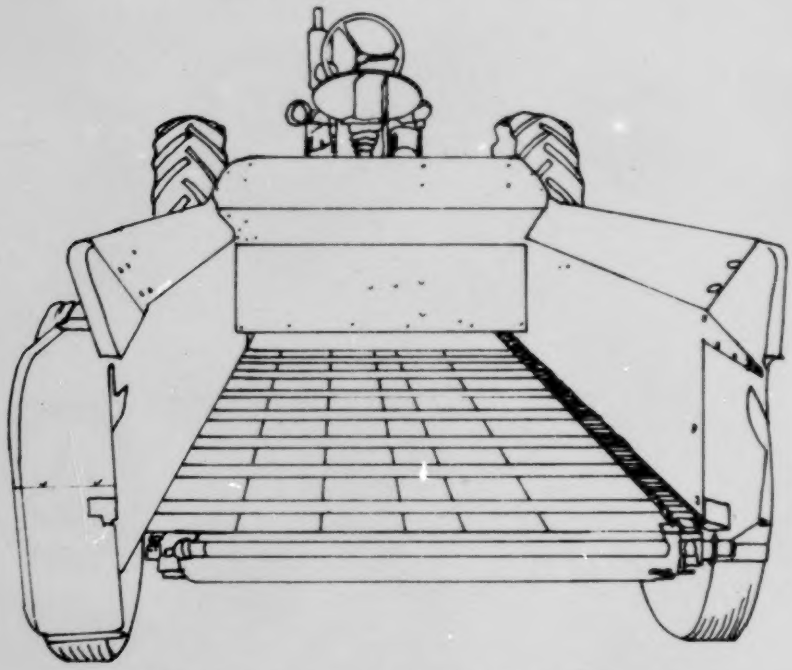
MANURE SPREADER SHOWING POSITION OF BEATERS AND WIDESPREAD AND DRIVE CHAIN IN RAISED OUT-OF-GEAR POSITION


upper beater
raddle apron
lower beater
control ropes
power take-off shaft
covered gear box
drive shaft
cross chain drive

TRACTOR-TRAILER POWER-TAKE-OFF-DRIVEN MANURE SPREADER



(A) REGULAR-PITCH CHAIN; (B) DOUBLE-PITCH ROLLER CHAIN;
(C) PINTLE CHAIN; (D) DETACHABLE-LINK CHAIN



REAR VIEW OF MANURE-SPREADER BOX

Assignment Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Fertilizers

TOPIC: Dry Fertilizer Distributors

OBJECTIVE: To develop an understanding of the types of dry fertilizer distributors and their use. Also, to understand the different parts of a fertilizer distributor and how these parts operate.

REFERENCES:

1. Farm Machinery and Equipment, pp. 275-280
2. Machines for Power Farming, 257-265
3. Information Sheet, "Dry Fertilizer Distributors"

QUESTIONS OR ACTIVITIES:

1. Name the two types of dry fertilizer distributors.
2. List the major parts of a dry fertilizer distributor.
3. Tell how the size of a fertilizer distributor is determined. What are the sizes and capacity ranges of fertilizer distributors?
4. What are the two principal cross-sectional shapes of hoppers?
5. Explain the difference between a rotor and an agitator.
6. List the steps necessary for cleaning and protecting a distributor.

Information Sheet
on
DRY FERTILIZER DISTRIBUTORS

As more and more fertilizer is being used to increase yields, the demand for distributors has also increased. Fertilizer may be applied in solid, liquid, or gaseous form. Dry fertilizer distributors will be discussed in this unit. These distributors or spreaders will put out all types of solid fertilizers at a uniform rate over a wide range of conditions. By changing the rotor, some machines may even be used to sow grass seed.

These machines may be either tractor mounted or trailing type. They also vary in size, which is determined by the sowing width. The normal range is from 8 to 12 feet.

These distributors have several components, the first two being agitators and rotors. The agitators are located in the upper portion of the hopper and prevent the fertilizer from bridging. The rotor is the device that forces the fertilizer through the machine.

Shutters are used to regulate the flow of fertilizer. These are controlled by levers. Shutters are the main point of corrosion and should be kept as clean as possible.

Hoppers hold the fertilizer and contain the agitators and rotors. These may have one sloping side and one vertical side (to prevent bridging), or they may have two sloping sides. Hoppers are made of heavy gage metal but are subject to high corrosion and must be cleaned after every use. They usually have an angle iron frame for added strength.

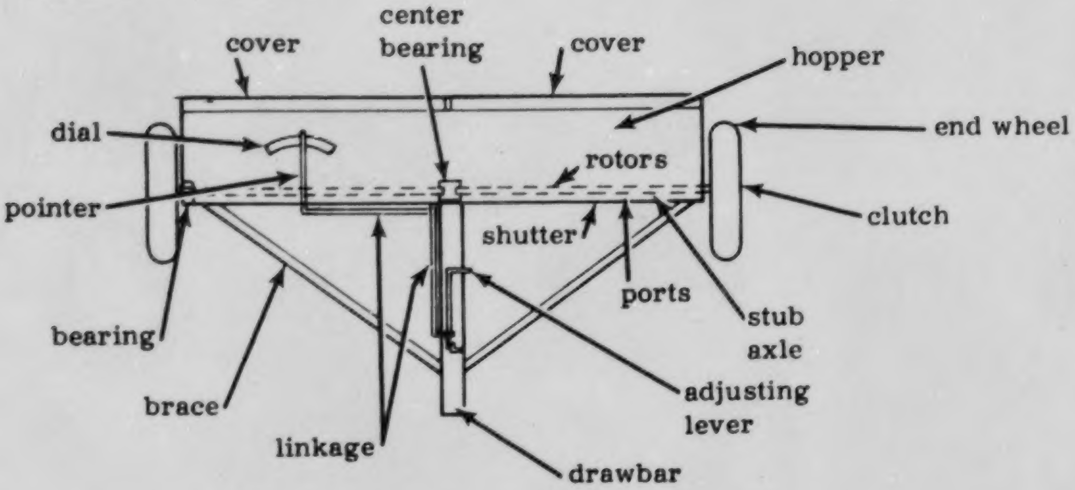
Clutches are available on some models. These help decrease packing of fertilizer and make transport easier.

Some models have axles that pass completely through the hopper from wheel to wheel. Others, which are more popular, have a split axle that allows each wheel to turn half of the rotor independent of the other.

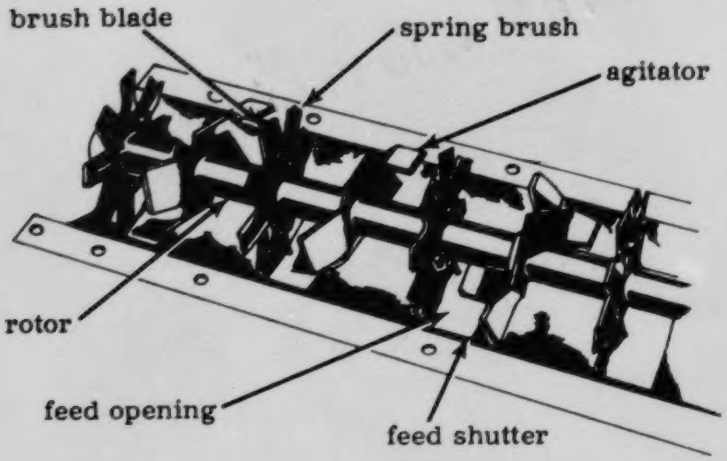
These machines are drawn by a drawbar that may pass all the way through to allow the attachment of other implements behind.

When cleaning a hopper and preparing for storage, these steps should be taken:

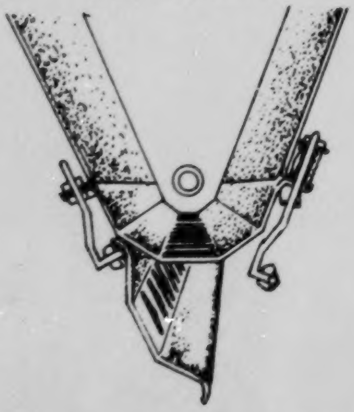
1. Use a whisk broom, stiff brush, air hose, or even water to clean and remove all fertilizer from moving parts.
2. Clean until no fertilizer remains.
3. After cleaning apply a mixture of 1/2 crankcase oil 1/2 kerosene or diesel to distributor.
4. Use rust preventive when storing for the season. It will last longer than the oil and kerosene.


center
bearing
cover
cover
hopper
dial
end wheel
rotors
pointer
clutch
shutter
ports
stub
axle
bearing
adjusting
lever
brace
linkage
drawbar

END WHEEL LIME-FERTILIZER DISTRIBUTOR PARTS


brush blade
spring brush
agitator
rotor
feed opening
feed shutter

ROTOR PARTS



METHOD OF QUICKLY
DROPPING SHUTTER BOTTOM

Assignment Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Fertilizers

TOPIC: Liquid and Gas Fertilizer Equipment

OBJECTIVE: To develop an understanding of the different parts of an applicator and their functions and how to calibrate liquid and gas equipment.

REFERENCES:

1. Farm Machinery and Equipment, pp. 281-287
2. Information Sheet, "Liquid and Gas Fertilizer Equipment"

QUESTIONS OR ACTIVITIES:

1. List the various types of fertilizers available in liquid or gas form.
2. Name the different types of fittings which are found on anhydrous ammonia applicators.
3. What is the purpose of a metering device?
4. Calibrating anhydrous ammonia equipment is important. A simple method of calculating the pounds or gallons of ammonia applied per hour is as follows:

   Operate the equipment in the field at a set speed over a measured distance two or three times. Take the average travel time for the distance, then apply the following formula:

   $$\frac{\text{ft. per sec.} \times \text{sec. per hr.} \times \#\text{ of rows} \times \text{row spacing (ft.)} \times \text{lbs of N per acre}}{\text{sq. ft. per acre} \times 0.82}$$

   From the information given above, solve the following problem:

   Forty pounds of nitrogen per acre is to be applied with 4-row equipment (one application to each 40" row spacing). The trial run gave a travel rate of 420' per minute, or 420/60 = 7' traveled per second. Calculate the gallons of ammonia used per hour.

Information Sheet
on
LIQUID AND GAS FERTILIZER EQUIPMENT

Liquid fertilizers are available in high pressure, low pressure, and nonpressure forms. To handle the various forms of fertilizer, the application equipment must be specially built. The tanks may be made of steel, aluminum, or fiberglass and lined with rubber, neoprene, polyethylene, and vinyl resins. Another example of special equipment is the anhydrous ammonia tank which should be equipped with the following fittings:

1. 300-pound pressure gauge
2. Liquid outlet valve screwed directly into the shell of the tank and connected to a pipe extending down into the tank to within 1/2" to 3/4" of the bottom. The bottom end should have a 1/64" strainer.
3. Safety or pop-off valve set for 250 p.s.i.
4. A 3/4" to 1" automatic back-seating, liquid-filling valve
5. A liquid level gauge
6. Vapor return valves, 1/2" to 3/4" with a short pipe extending into the tank to prevent filling to over 85% capacity and used for gas escape

This anhydrous ammonia applicator also has a metering device that regulates the flow at the desired rate per acre.

Satisfactory use of liquid fertilizers depends largely upon having the equipment properly calibrated. Fortunately, this is fairly simple.

Where nozzles and orifices (flow regulators) are used, manufacturers furnish information which shows the quantity of fertilizer applied at various pressures and speeds. The speed can be determined by placing two markers in the field 88' apart and getting the time (in seconds) it takes the applicator to travel this distance. To get the speed in miles per hour, divide the time in seconds into 60.

How To Calibrate

Calibrate the gravity flow applicators by using a needle valve to adjust the rate of flow or by changing the head alone and operating without valves. If the head alone is changed, the siphon breaker vent should be lifted above the bottom of the fill tube to stop the flow, as shown in Figure 1. Equip the tank with a clear plastic hose fastened to the top and bottom of the tank (Figure 2). Fill the tank by pouring in five gallons of solution at a time. Mark the level for each five gallons on the head of the tank. Make a trial setting of the regulating valve or the pressure head and apply the fertilizer to a known area. The calibrated barrel head will show if the valve setting or pressure head needs changing for the desired application.

Liquid and Gas Fertilizer Equipment
(Information Sheet continued)

Anhydrous Ammonia

Anhydrous ammonia exists under pressure as a liquid but expands quickly into a gas at atmospheric pressure. It weighs about five pounds per gallon and contains 4.2 pounds of nitrogen per gallon. It must be handled in high pressure tanks made of carbon steels and is applied 4" to 6" in the ground. Since ammonia equipment is normally covered by state safety codes, it is not discussed here.

Phosphoric Acid

Phosphoric acid may be applied directly. Wet process or green acid is commonly used. Phosphoric acid weighs about 14 pounds per gallon and usually contains 54% P_2O_5. The acid is very corrosive to mild steel.

Use a gravity flow system. Permanent equipment should be made of type 316 stainless steel. Plastic liners may also be obtained for mild steel containers. Diaphragm valves and plastic hose complete the equipment necessary to dribble the acid on or into the ground.

Potash

Muriate of potash is generally used as a source of K_2O. As a solid, it usually exists as 62% K_2O equivalent. It is readily soluble in water and can be diluted to a 20% solution. It is a salt and is very corrosive to mild steel. Apply it to gravity flow on or into the ground, using stainless steel drums or plastic containers.

Complete Neutral Solutions

Complete neutral solutions are made by combining nitrogen, phosphorus, and potash. The phosphoric acid is neutralized with anhydrous or aqua ammonia. Any additional nitrogen needed may be provided by using nitrate nitrogen solutions. Potash is added in the form of muriate of potash. The resulting mixture weighs about ten pounds per gallon and contains up to thirty pounds of plant food per 100 pounds.

Nitrogen Solutions

Solutions made from ammonium nitrate, urea, and water are non-pressure-forming. They contain 18% to 32% nitrogen and weigh 10 to 12 lbs. per gallon. Apply this sol-

Liquid and Gas Fertilizer Equipment
(Information Sheet continued)

ution either on top of the ground, in the ground, or in irrigation water. Use aluminum or stainless steel containers. Avoid such materials as brass, copper, or monel.

Solutions made from ammonium nitrate and water but containing free ammonia are pressure-forming. Their nitrogen content varies from around 25% to 41% and weighs 7 to 9-1/2 pounds per gallon.

Since this solution contains free ammonia, apply it to a depth of 2" to 3" in the ground. Use closed aluminum or stainless steel tanks.

Aqua ammonia is a combination of anhydrous ammonia and water. The nitrogen content varies from 18% to 24%. It is slightly pressure-forming and weighs about 7 pounds per gallon. Apply this mixture to a depth of 2" to 3" in the ground. Use closed mild steel containers.

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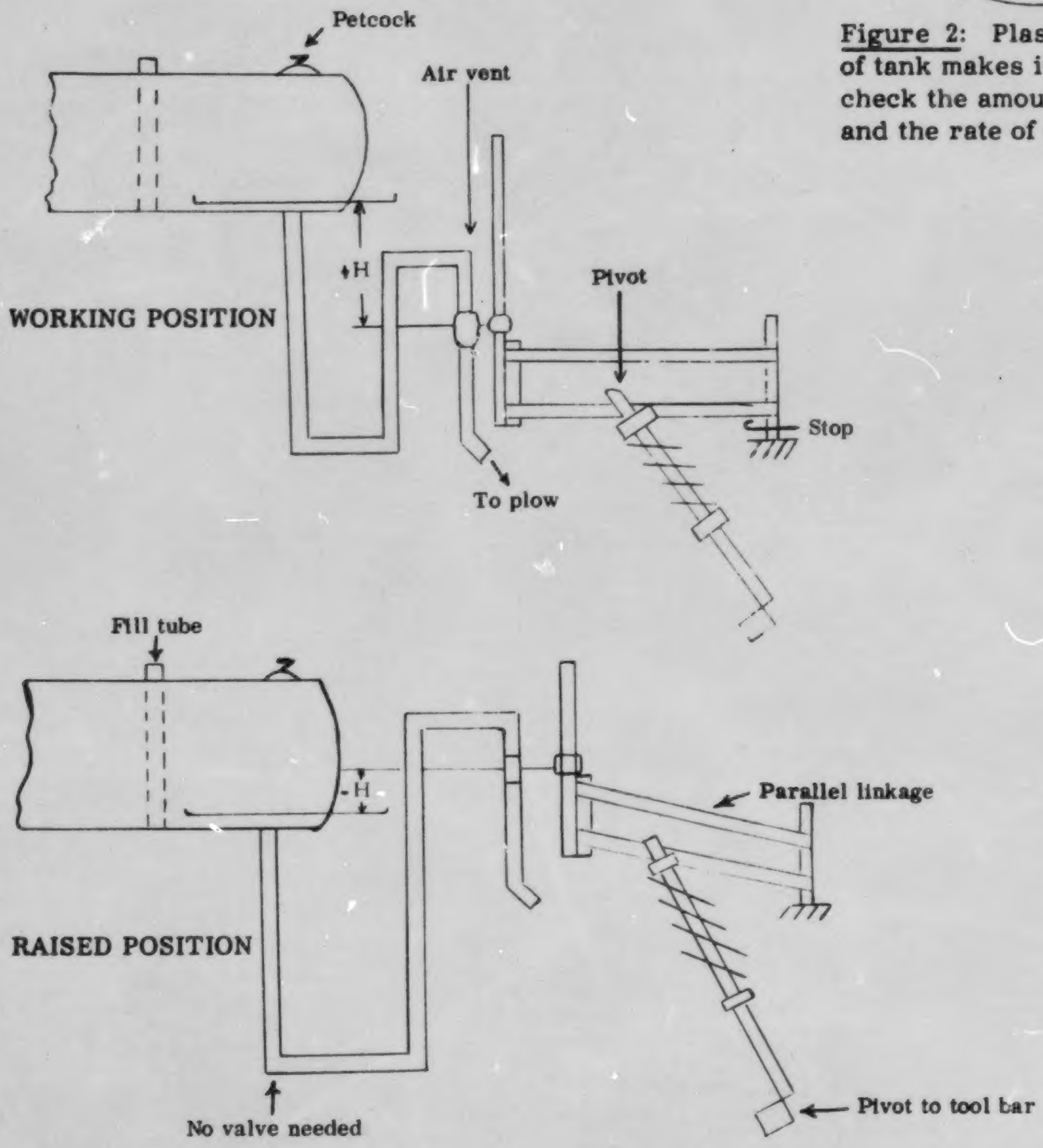
Material for this Information Sheet was taken from "Choose the Right Liquid Fertilizer Equipment," Louisiana Agricultural Extension Service.

Liquid and Gas Fertilizer Equipment
(Information Sheet continued)

Figure 1: No valves are needed in this setup. When combined with the plowing operation, the flow is started when the tool bar is lifted. (Courtesy Georgia Experiment Station)


Petcock
Air vent
H
Pivot
WORKING POSITION
Stop
To plow
Fill tube
H
Parallel linkage
RAISED POSITION
No valve needed
Pivot to tool bar

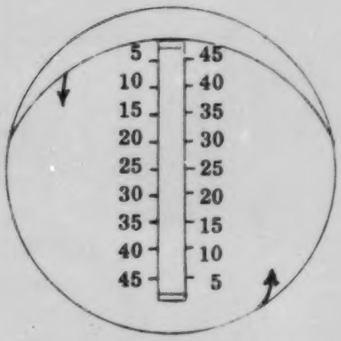

5
10
15
20
25
30
35
40
45
45
40
35
30
25
20
15
10
5

Figure 2: Plastic tube on end of tank makes it possible to check the amount in the tank and the rate of application.

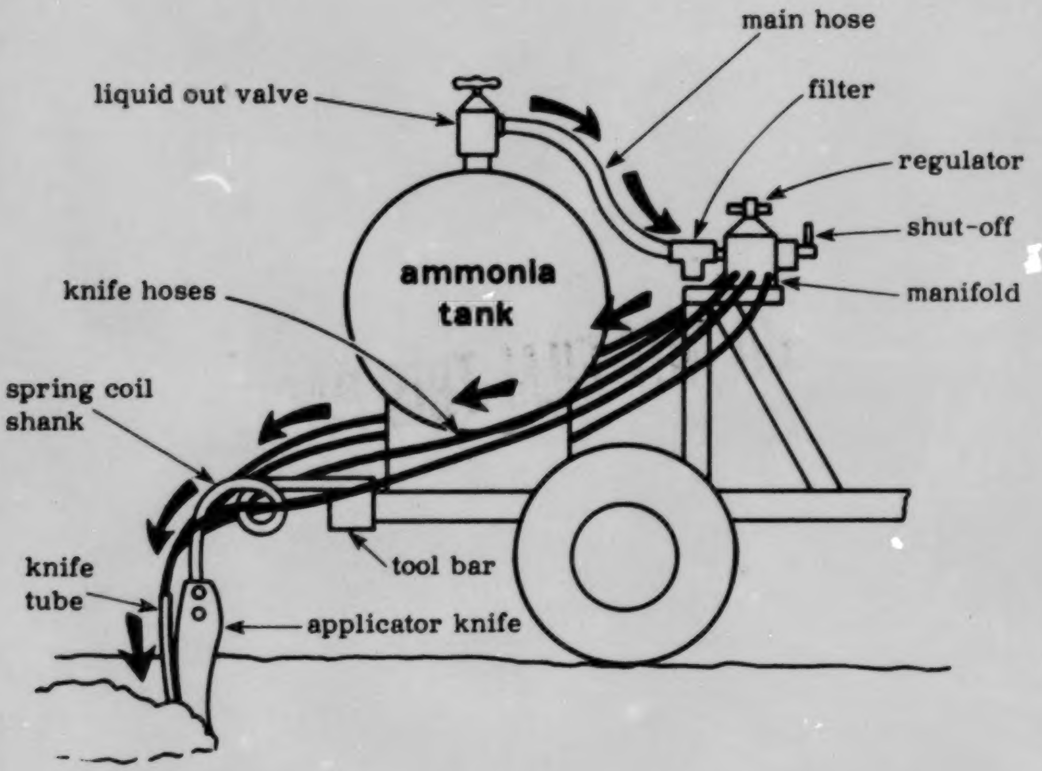
TABLE 1 - SUMMARY OF RECOMMENDATIONS

Type Fertilizer	Plant Food	Vapor Pressure at 104° F.	Design Pressure	Recommended Tank Material	Closed or Open System	Method of Application	Type of System	Materials to Avoid
Anhydrous Ammonia	82%N	211 psi	250	Steel	Closed	Subsurface	Pump Press. Differ.	Brass Copper Monel
Aqua Ammonia	Up to 25%N	Up to 10 psi	15	Steel	Closed	Subsurface	Pump Air	Brass Copper
Complete Neutral Solution	Up to 30 units N - P - K	0	15	Steel Fiberglass-lined	Open	Subsurface Surface	Pump Air Gravity	Aluminum Brass
Ammonium Phosphate (Neutral)	Up to 30 units N - P	0	15	Steel Fiberglass-lined	Open	Subsurface Surface	Pump Air Gravity	Aluminum Brass
Nitrogen Solution (non-press.)	15 to 32%N	0	15	Aluminum Fiberglass-lined	Open	Subsurface	Pump Air Gravity	Brass Monel
Nitrogen Solution (low-press.)	25 to 41%N	1 to 17	30	Aluminum Fiberglass-lined	Closed	Subsurface	Pump Air	Brass Monel Mild steel
Phosphoric Acid	64% P_2O_5	0	15	Stainless steel Fiberglass-lined	Open	Subsurface Surface	Gravity Air	Aluminum Brass Mild steel

Note 1: Tanks may be lined with rubber, neoprene, polyethylene, and vinyl resins.

Note 2: If other means are used to give the tank rigidity, it is not necessary to design for 15 psi where zero pressure is to be encountered.

Liquid and Gas Fertilizer Equipment
(Information Sheet continued)


main hose
liquid out valve
filter
regulator
shut-off
ammonia tank
knife hoses
manifold
spring coil shank
tool bar
knife tube
applicator knife

Flow Regulator Assembly and Applicator Parts

TYPICAL SMALL TRAILING ANHYDROUS AMMONIA APPLICATOR

Assignment Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Combines

TOPIC: Introduction

OBJECTIVE: To develop an understanding of the grain harvester, its history, and its basic design. To understand the types and sizes available and the breakdown into principal units.

REFERENCES:

1. Farm Machinery and Equipment, pp. 330-341
2. Machines for Power Farming, pp. 470-491
3. Information Sheet, "Grain Harvester"

QUESTIONS OR ACTIVITIES:

1. What are the power classifications of combines?
2. List the two general types of combines available today.
3. List the six basic operational functions of a combine.
4. Give the steps in history which lead to today's combine.
5. How are combine sizes expressed?
6. List the six principal units of a combine.

Information Sheet
on
GRAIN HARVESTER

The combine is so called because it "combines several jobs into a single operation". Two steps of progress led to the modern combine - the development of the reaper and the thresher. The first combine came about with the union of these in 1836. Today there are two general types or power classifications of combines. The self-propelled combine is considered a complete harvesting unit, as its power comes from a built-in engine. The tractor drawn machine is driven either by the power take-off or an auxilliary engine.

The combine has six basic functions it performs in order to produce clean threshed grain. These are:

1. Cutting the standing grain - Cutting unit
2. Feeding the cut grain to the cylinder - Feeding unit
3. Threshing grain from the stalk or stem - Threshing unit
4. Separating the grain from the straw - Separating unit
5. Cleaning the grain by removing chaff and other foreign material - Cleaning unit
6. Grain handling from combine to tank to truck

Combine size is normally expressed by the width of cut of the header. Smaller sizes have a swath of 5 feet, while larger machines can cut as much as 24 feet in a single pass.

The operation of the combine is quite simple. A brief explanation is as follows:

The reel (1) momentarily holds the crop against the guards until the knife (2) cuts the stems, and then it sweeps the cut material onto the platform. The platform auger (3) delivers the cut grain to the feeder (4), which carries the cut grain to the cylinder (5). The grain is rubbed out of the head between the rotating cylinder and the concave grates (6). The cylinder beater (7) strips the cylinder, continues separating loose kernels of grain through the finger grate (8), then moves the material onto the straw rack (9) where final separation takes place. The adjustable cylinder beater check flap (10) regulates the flow of material over the racks. The grain pan (12) catches the grain separated at the concave cylinder beater grate and the return from the straw racks and delivers it to the chaffer (11). The cleaning fan (15) supplies the wind blast which is the medium of separation. The shoe sieve (13) operates in the direct opposite to the grain pan and chaffer which assures double-action cleaning (as the grain pan and chaffer move forward, the shoe sieve moves toward the rear). The shoe sieve is where the final cleaning takes place. The threshed grain falls through the chaffer and

Grain Harvester
(Information Sheet Continued)

shoe sieve and into the grain trough, where is it moved to the grain elevator by the grain auger (14). The grain elevator conveyor chain then delivers the clean grain to the grain tank. Unthreshed heads will move toward the rear across the chaffer and shoe sieve and will drop into the tailings return auger trough (16). From this point, the unthreshed heads are returned by the tailings elevator to the cylinder for re-threshing.

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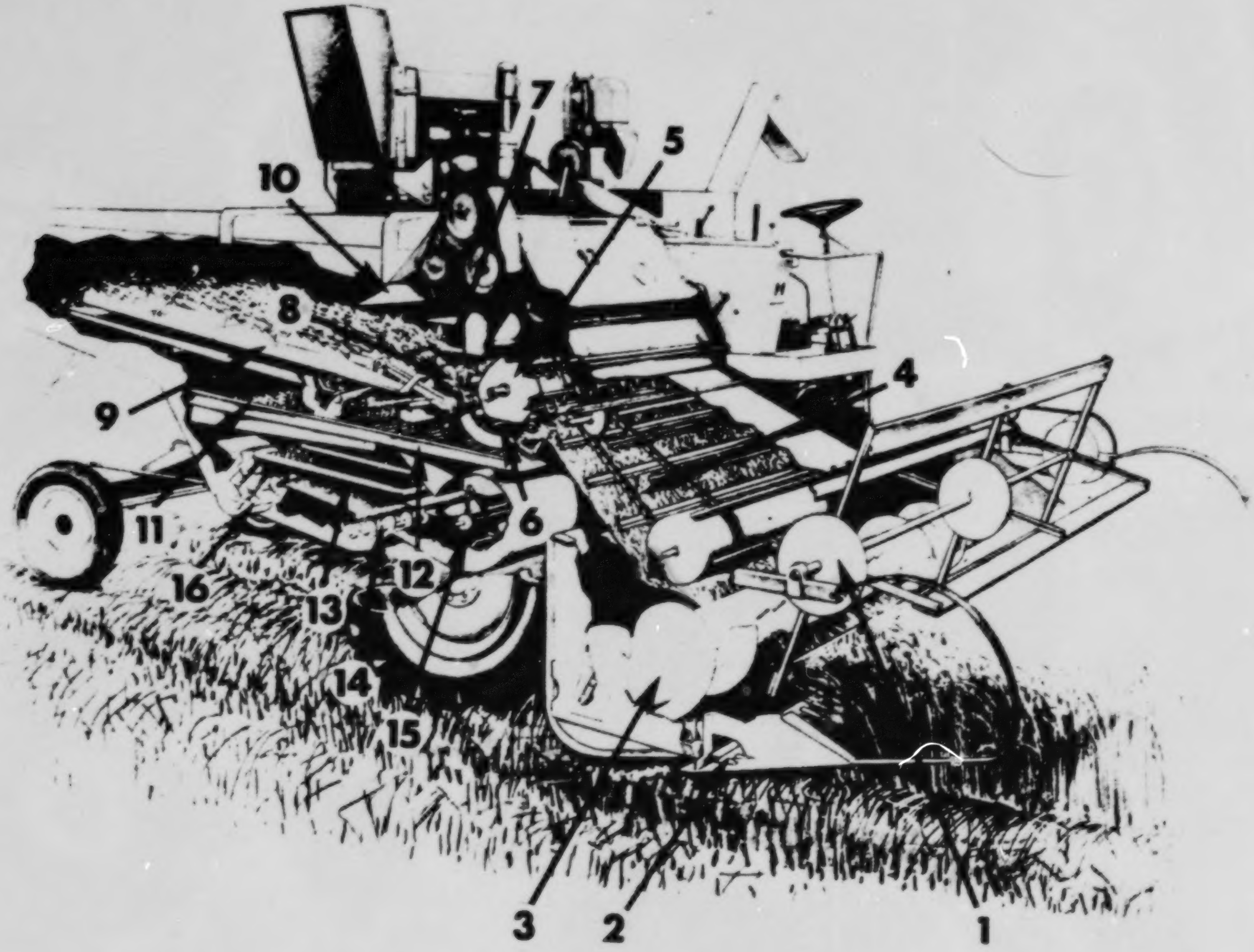
Materials for this Information Sheet was taken from Combines and Combining, Vocational Agriculture Service, State Department of Education and Department of Agricultural Education, The Ohio State University, 1965.


1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16

COMBINE OPERATING CYCLE

Grain Harvester
(Information Sheet continued)

Man-Hours Required to Harvest One Acre of Wheat
(Courtesy International Harvester Company)

	Man-Hours
Cutting with sickle	14
Binding by hand	5
Shocking	1
Threshing with flail	13
Winnowing rod and sheet	10
Gathering and sacking	3
TOTAL	46

	Man-Hours
Cutting with cradle	5
Binding by hand	5
Shocking	1
Threshing with flail	13
Winnowing rod and sheet	10
Gathering and sacking	3
TOTAL	37

	Man-Hours
Cutting with McCormicks's first 4/1/2' reaper	2
Binding by hand	5
Shocking	1
Threshing with flail	13
Winnowing rod and sheet	10
Gathering and sacking	3
TOTAL	34

	Man-Hours
Cutting with 5' grain binder	3/4
No binding	
Shocking	1
Stationary thresher	1-1/4
No winnowing rod and sheet	
No gathering and sacking	
TOTAL	3

	Man-Hours
Using 14' combine	1/2
No binding	
No shocking	
No threshing	
No winnowing rod and sheet	
No gathering and sacking	
TOTAL	1/2

Assignment Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Combines

TOPIC: Cutting, Feeding, and Threshing Mechanisms

OBJECTIVE: To develop an understanding of the parts of a cutting, feeding, and threshing mechanism and how they operate.

REFERENCES:

1. Machines for Power Farming, pp. 470-491
2. Farm Machinery and Equipment, pp. 330-341
3. Information Sheets, "Cutting and Feeding Mechanism" and "Threshing Mechanism"

QUESTIONS OR ACTIVITIES:

1. List and explain the function of each major part of the cutting mechanism.
2. List and explain the function of each major part of the feeding mechanism.
3. List and explain the function of each major part of the threshing mechanism.

Information Sheet
on
CUTTING AND FEEDING MECHANISM

The main parts of the cutting and feeding area are:

a. Cutter bar: The cutter bar works like a series of shears running through the field to cut the grain. This is accomplished by knife sections reciprocating (working back and forth) over ledger plates which are held in place by guards. Hold-down clamps, wearing plates, and shims are used to keep the knife flat on the ledger plates. The sickle bar is usually driven by a pitman drive assembly. Power will usually be supplied to the pitman crank by means of a series of belts and chains.

b. Reel: The reel slats gather in the crop, hold it until it has been cut by the knife, and then move it onto the platform. The reel must be square, level, and at the proper height and position to feed the grain uniformly and steadily. The reel may be ground-driven or power-driven.

c. Platform: The platform holds the cutter bar and feeding mechanisms.

d. Cutting platform auger: The cutting platform auger moves the cut grain to the center of the platform where the retractable auger fingers feed the grain into the feeder conveyor or the feeder beater, depending on the design of the combine.

e. Retractable finger feeder beater: In some combines the cutting platform auger is followed by a retractable finger feeder beater which moves the grain into either the feeder conveyor or into the threshing unit.

f. Feeder conveyor: The feed conveyor, or feed rake, as it is sometimes called, is designed to feed the grain in a steady, even flow into the threshing unit. Proper feeding into the threshing unit will cause less clogging.

g. Feeder beater: Some models of combines will have a feeder beater which takes the grain from the feed conveyor and feeds it uniformly into the threshing unit.

Student exercise: Study the combines you have in the school shop or at home and make a schematic drawing of the cutting and feeding areas. Label all the parts and describe the flow of the grain. Use the operator's manual for the machine.

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Material for this Information Sheet was taken from Combines and Combining.

Information Sheet
on
THRESHING MECHANISM

The main parts of the threshing unit are:

- a. Cylinder: The cylinder will have either bars or spikes that will cause the rubbing of the grain against the concave.
  - (1) Rasp bar cylinder: The cylinder bars are rasp-shaped, as shown in the illustration.
  - (2) Rub bar cylinder: The cylinder bars are angle-shaped and faced with rubber.
  - (3) Spiked tooth cylinder: The cylinder has spikes instead of bars; this type is not suited for corn harvesting.
- b. Concave: The concave is the stationary part against which the cylinder works in the threshing action. It is the rubbing action between the cylinder bars and the concave bars that removes the seed from the head or pod. The concave is a grate composed of rods and bars or wires. It is at the concave grate and finger grate that as much as 90% of the grain is separated from the husk. The separated grain falls through the grate onto the shoe pan where it is delivered to the cleaning unit. The straw and the remaining grain pass on into the separation unit. One make, the Gleaner combine, separates the grain from the straw by use of a raddle located behind the cylinder. Clean grain falls through the suspended straw and is conveyed to the cleaning shoe.
- c. Cylinder beater: The beater behind the cylinder slows down the material coming from the cylinder, tears apart the straw, and delivers the material to the straw from the cylinder, thus preventing cylinder wrapping and feedback.
- d. Feeding plate: The feeding plate is an adjustable plate located where the cut grain is fed into the cylinder concave unit. Much of the threshing can be done here.
- e. Cylinder stripper: The cylinder stripper is set parallel to and above the cylinder and prevents back feeding.

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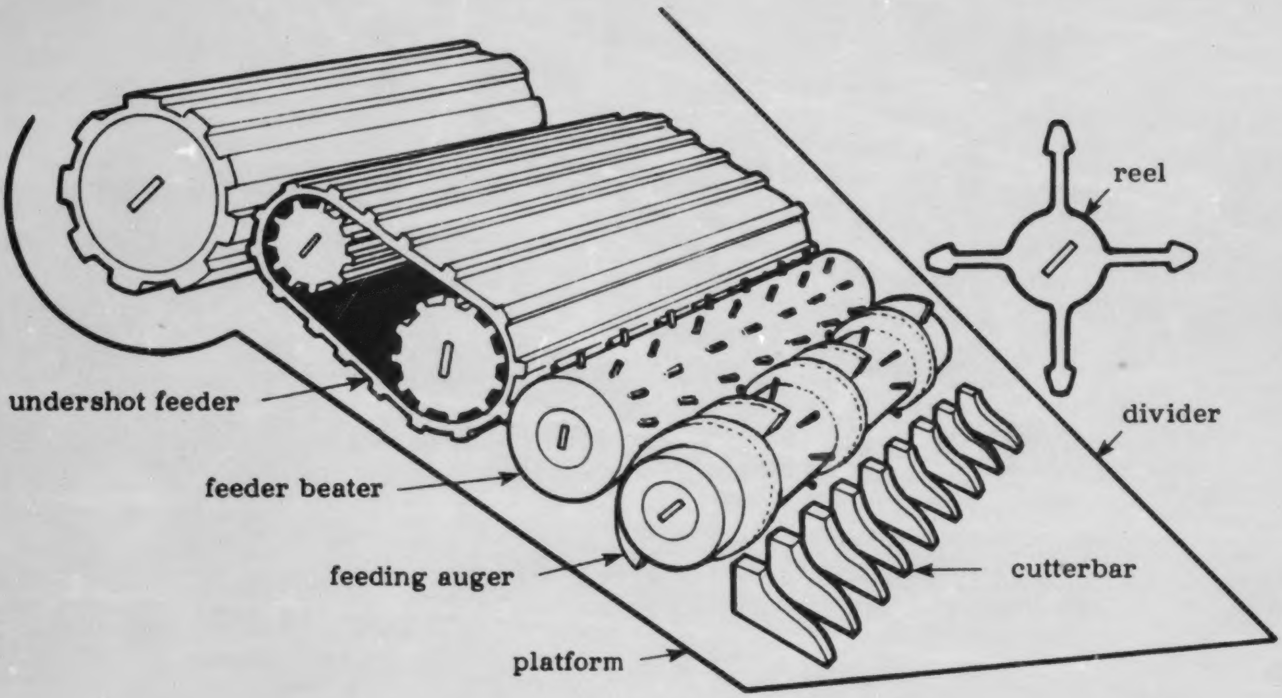
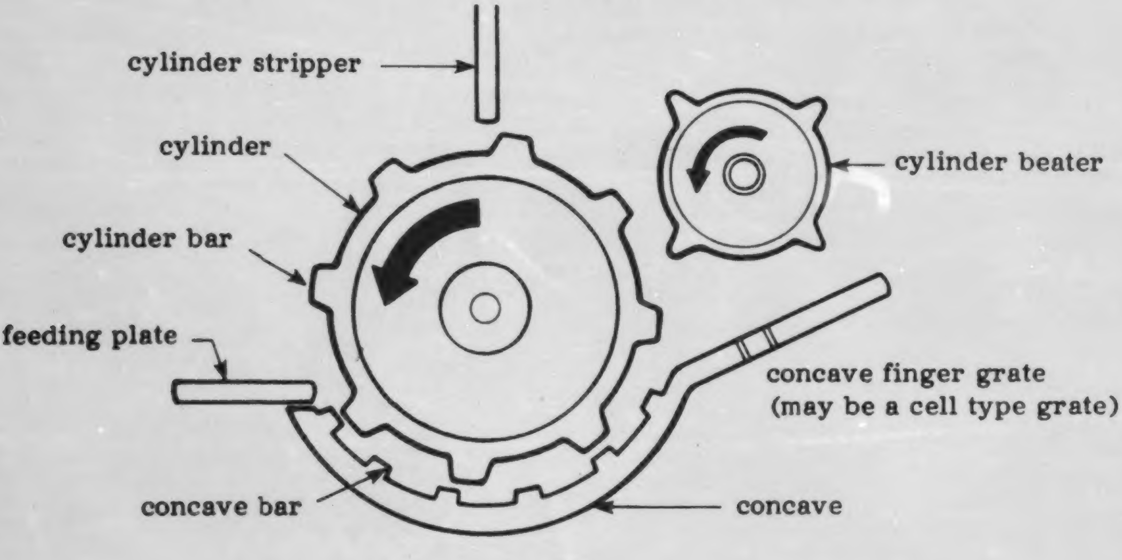
Material for this Information Sheet was taken from Combines and Combining.


reel
divider
undershot feeder
feeder beater
feeding auger
cutterbar
platform

CUTTING AND FEEDING UNIT USING A FEEDING AUGER, FEEDER BEATER, AND UNDERSHOT FEEDER


cylinder stripper
cylinder
cylinder beater
cylinder bar
feeding plate
concave finger grate
(may be a cell type grate)
concave bar
concave

THRESHING UNIT

Assignment Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Combines

TOPIC: Separating and Cleaning Mechanisms

OBJECTIVE: To develop an understanding of the parts of separating mechanisms and the functions of each.

REFERENCES:

1. Machines for Power Farming, pp. 470-491
2. Farm Machinery and Equipment, pp. 330-341
3. Information Sheets, "Combine Separating Mechansim" and Combine Cleaning Mechanism"

QUESTIONS OR ACTIVITIES:

1. List and explain the function of each major part of the separating mechanism.
2. List and explain the function of each major part of the cleaning mechanism.

Information Sheet
on
COMBINE SEPARATING MECHANISM

The main parts of the separating area are:

a. Concave grate and finger or cell grate which have been described in the threshing unit

b. One-piece straw rack: The straw rack is a one-piece unit with risers pointed toward the rear of the combine. The straw rack is mounted on cranks located at the front and rear which give it an oscillating motion. As the rack moves rearward and upward, the straw is tossed up and to the rear. As the rack returns forward and downward, the straw stays in mid-air for a short time and then falls onto a section of the rack nearer the end of the combine. In this way the straw moves step by step out of the combine. This action causes the grain to be separated from the straw.

c. Walker type straw rack: Some large combines may use a walker type straw rack which operates on the same principle as the rack. The straw walker has three or more narrow sections placed side by side. Each section is mounted on multiple throw cranks located at the front and rear. The crank throws for each section are equally spaced around the circle of rotation; thus, the sections do not operate as a unit as the rack does.

d. Grain return pan: The grain return pan is located under the straw rack. It catches the grain as it falls through the rack and moves forward to the grain pan. The straw walker has a return pan under each unit.

e. Grain return conveyor: In place of the grain return pan, some combines will use a conveyor to catch the grain and move it forward.

f. Grain pan: The grain pan is usually located under the forward part of the straw rack behind and below the cylinder. Its function is to catch the grain from the concave and cylinder grates and from the grain return pan or conveyor for delivery to the cleaning unit.

g. Grain conveyor: Some combines will use a conveyor instead of the grain pan to collect and deliver grain to the cleaning unit.

h. Check flaps or curtains: The check flaps or curtains deflect the straw and grain onto the rack as the full length of the rack is used for separation. They should not be in the way of the straw as the rack moves it to the rear.

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Material for this Information Sheet was taken from Combines and Combining.

Information Sheet
on
COMBINE CLEANING MECHANISM

The main parts of the cleaning area are:

a. Adjustable chaffer: The adjustable chaffer acts as a sieve. It is made up of a series of cross pieces mounted on rods and fastened together so they can be moved at the same time to adjust the size of the openings.

b. Chaffer extension: As the name suggests, this is an extension of the chaffer. In addition to having adjustable lips the chaffer extension will also swing up and down on the end of the chaffer. The unthreshed portions of grain heads fall through the chaffer extension into the tailings auger. The bulky material passes over the chaffer extension and out of the combine.

c. Sieve: The sieve is like the chaffer except that the lips and openings are smaller. The final job of cleaning is done here. The material that is too large to pass through the sieve is carried over to the tailings auger and returned to the cylinder for rethreshing.

d. Special chaffer and sieve equipment: Many combines will have special screens available for some crops that are difficult to clean.

e. Cleaning fan: The fan furnishes a blast of air. The strength of the air blast is controlled by the speed of the fan and by shutters in the air intake. The direction of the air blast is controlled by windboards. The function of the air blast is to keep the material "alive" on the chaffer and sieve. The air blast should be strong enough to lift the chaff slightly off the chaffer and sieve, but not strong enough to blow grain out of the combine.

f. Clean grain auger and clean grain elevator: The clean grain auger collects the cleaned grain and augers it to the clean grain elevator which delivers the clean grain to the grain tank.

g. Tailings auger and tailings elevator: The tailings auger collects all of the material which comes off the lower sieve plus any material which falls through the extension chaffer.

h. Tailboard: The tailboard keeps the unthreshed material from being carried out of the rear of the combine while still allowing the chaff to be blown out. It may be raised or lowered as needed.

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Material for this Information Sheet was taken from Combines and Combining.

Assignment Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Combines

TOPIC: Grain Handling Unit and Combine Attachments

OBJECTIVE: To develop an understanding of the parts of a grain handling unit and the functions of each.

REFERENCES:

1. Farm Machinery and Equipment, pp. 329-341
2. Machines for Power Farming, pp. 470-491
3. Information Sheet, "Grain Handling Unit and Combine Attachments"

QUESTIONS OR ACTIVITIES:

1. List the parts of the grain handling unit.
2. Give the functions of each of the above major parts of the grain handling unit.
3. List all of the different attachments available for combines.
4. In some areas, farmers find that cutting and windrowing the top portion of the plants with the grain attached permits earlier harvesting and protects the grain under certain conditions. List these conditions.
5. Explain how a combine with a corn head attachment operates.

Information Sheet
on
GRAIN HANDLING UNIT AND COMBINE ATTACHMENTS

The grain handling unit is the final step in the operation of the combine. It consists of:

1. Clean grain auger - collects the grain from the bottom of the shoe and conveys it across the combine to the elevator.
2. Clean grain elevator - elevates grain from the auger and discharges it into the grain tank.
3. Grain tank - retains grain (from 18 to 150 bushels) until a load is acquired.
4. Tank unloader - augers the grain from the tank to the wagon or truck.
5. Bagger and bag chute - on some models, sacks the grain with a two-spout bagger attachment replacing the grain tank; one bag is being filled while the other is being removed, tied, or sewed.

Several attachments may be obtained for a combine. These include:

a. Straw spreader
b. Straw windrower
c. Straw loader
d. Straw chopper
e. Windrow pickup
f. Windrow spreader
g. Bundle-topping vertical cutter bar
h. Flax roller
i. Bagger
j. Grain bin
k. Cylinder-speed tachometer
l. Scourkleen
m. Corn header

The scourkleen is a device that separates weed seed from the grain.

Corn may be harvested with combines if a corn head is attached. Other alterations for corn include concave and cylinder adjustments.

In some areas it is found that better results are achieved if the crop is cut and windrowed in advance. Some instances where this practice may be profitable are:

1. When grain is unevenly ripened
2. Fields are weedy
3. Straw is green but crop is ripe
4. Grain is high in moisture
5. On crops which tend to shatter if left until completely ripe
6. When weather conditions delay direct combining

This windrowing is achieved by the use of either a self-propelled windrower or a tractor pulled, PTO driven unit.

Assignment Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Corn Pickers

TOPIC: Introduction

OBJECTIVE: To develop an understanding of the corn picker, its history, and the types and sizes available. Also, to understand the breakdown into principal units and the factors affecting the performance of the corn pickers.

REFERENCES:

1. Farm Machinery and Equipment, pp. 343-353
2. Machines for Power Farming, pp. 492-510
3. Information Sheet, "Introduction to Corn Pickers"

QUESTIONS OR ACTIVITIES:

1. List the three kinds of corn picking machines.
2. Describe and explain the difference between each of the three kinds of machines.
3. The types of pickers are classified by the way they receive power. List the three types of corn pickers available and their power sources.
4. How is capacity expressed in corn pickers?
5. When conditions are favorable, give the rates in acres per day for the following types of pickers:
    a. One-row pull-type
    b. One row mounted-type
    c. Two-row mounted
    d. Two-row self-propelled
6. Give the power requirements for the different kinds of pickers.
7. The corn picker is made up of five mechanisms. Name these five.

Information Sheet
on
INTRODUCTION TO CORN PICKERS

The purpose of corn harvesting machines is to remove the corn ears from the standing stalks.

Three kinds of machines have been developed to perform this function:
1. Corn snapper 2. Corn picker 3. Corn picker-sheller

The corn snapper is the simplest machine because it only snaps the ears from the stalk without removing the husks from around the ears. The corn picker is the most commonly used corn harvesting machine. It snaps the ear from the stalk and removes the husks from the ears. A fairly new corn harvesting machine is the picker-sheller. It performs both the snapping and husking activities and, in addition, shells the corn.

The types of pickers are classified by the way they receive power:
1. Pull-type -- tractor-drawn and driven by the PTO
2. Mounted-tractor -- mounted and driven by the PTO
3. Self-propelled -- driven by its own source of power

Corn picker sizes are expressed by the number of rows for which a machine is designed. This varies from one to four rows. The harvesting capacity of these machines vary, but with favorable conditions these rates are possible:
a. One-row pull-type = 6 - 8 acres per day
b. One-row mounted-type = 8 - 10 acres per day
c. Two-row mounted = 20 acres per day
d. Two-row self-propelled = 20 - 30 acres per day

The power requirements for these machines also vary. Some of these are:
a. One-row corn snapper = one- or two-plow tractor
b. One-row corn picker = two-plow tractor
c. Two-row corn picker = two- or three-plow tractor

The corn picker is composed of several mechanisms that perform specific functions:
1. Gathering mechanism
2. Snapping mechanism
3. Husking mechanism
4. Cleaning mechanism
5. Shelling mechanism

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Material for this Information Sheet was taken from "Adjustment, Maintenance, and Repair of Crop Harvesting Machinery," Module No. 11, The Center for Research and Leadership Development in Vocational and Technical Education, The Ohio State University, Columbus, OH.

Assignment Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Corn Pickers

TOPIC: Gathering and Snapping Mechanisms

OBJECTIVE: To develop an understanding of the parts of a gathering mechanism and how it operates.

REFERENCES:

1. Machines for Power Farming, pp. 492-510
2. Farm Machinery and Equipment, pp. 434-353
3. Information Sheet, "Gathering and Snapping Mechanisms"

QUESTIONS OR ACTIVITIES:

1. List the parts of the gathering mechanism.
2. Give the functions of the three main parts of the gathering mechanism.
3. Sketch the gathering mechanism and label the three parts.
4. List the major parts of the snapping mechanism.
5. Explain how the snapping mechanism operates.

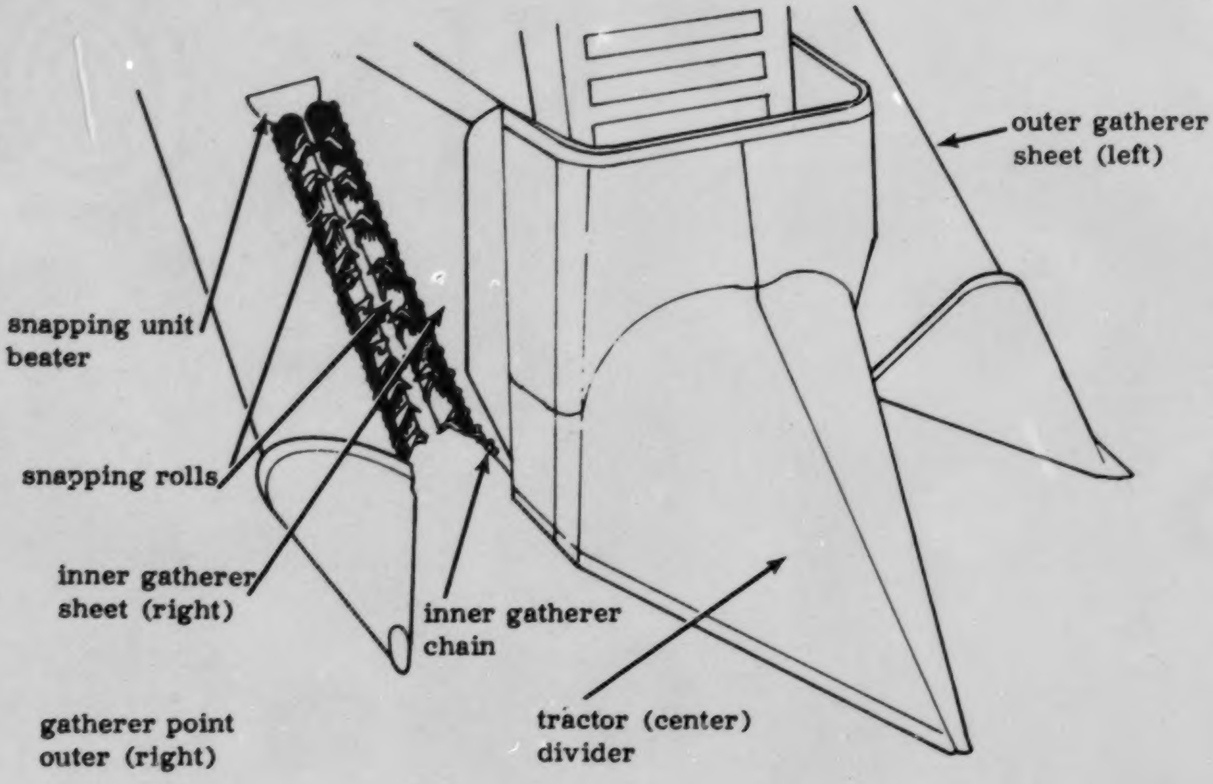
Information Sheet
on
GATHERING AND SNAPPING MECHANISMS

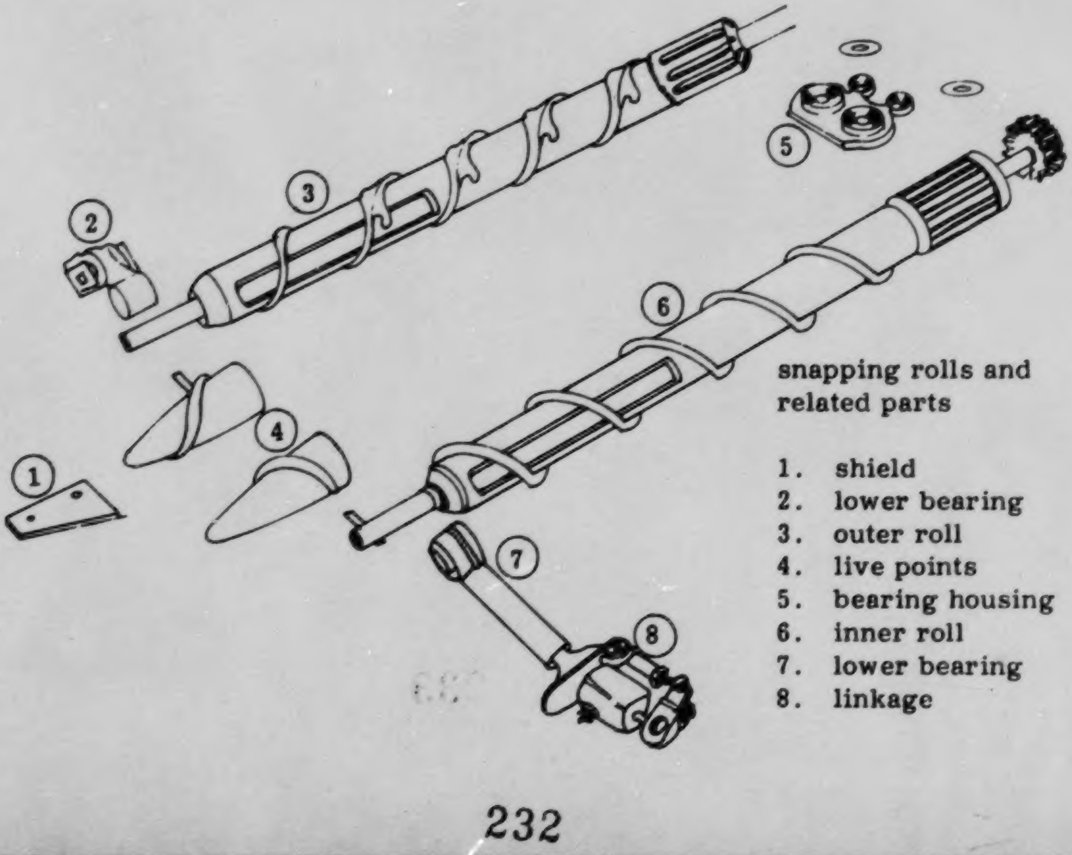
Gathering and snapping mechanisms are the first two in a series that combine to give clean shelled corn in the field. The gathering mechanism is made up of three main parts. The points, also called a "snout", direct the stalks into the throat of the mechanism. The gathering chains then pull the stalks into the snapping rolls. Two or three gathering chains are used on each row. The dividers divide the rows. In some models the center divider is steered with the tractor steering wheel.

The snapping mechanism removes the corn ears from the corn stalk. This function is performed by two long, closely-spaced rolls. The rolls slant upward and turn toward each other at a high speed. The snapping rolls are equipped with spiral lugs which grip into the corn stalk and pull them down through the rolls. As the stalks are pulled down through the snapping rolls, the corn ear is pinched off the stalk and conveyed on to the husking rolls.

The snapping rolls consist of:

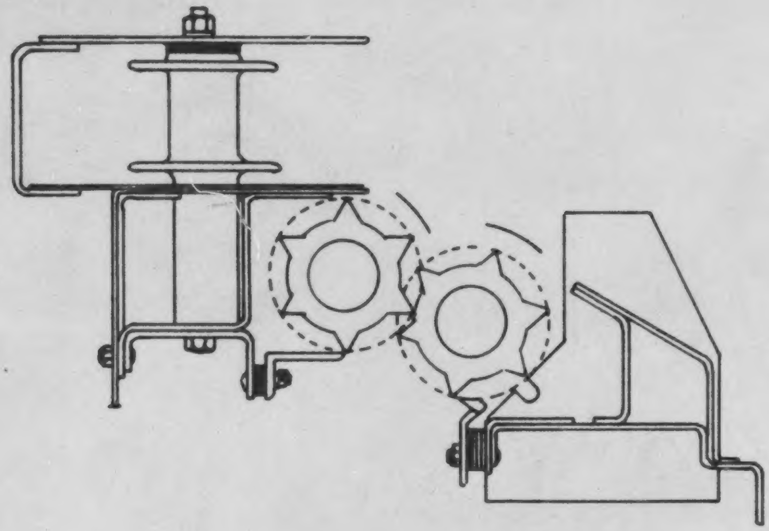
a. Shield
b. Bearing on the lower end of each roll
c. Outer roll
d. Live points
e. Bearing housing
f. Inner roll
g. Linkage


outer gatherer sheet (left)
snapping unit beater
snapping rolls
inner gatherer sheet (right)
inner gatherer chain
gatherer point outer (right)
tractor (center) divider

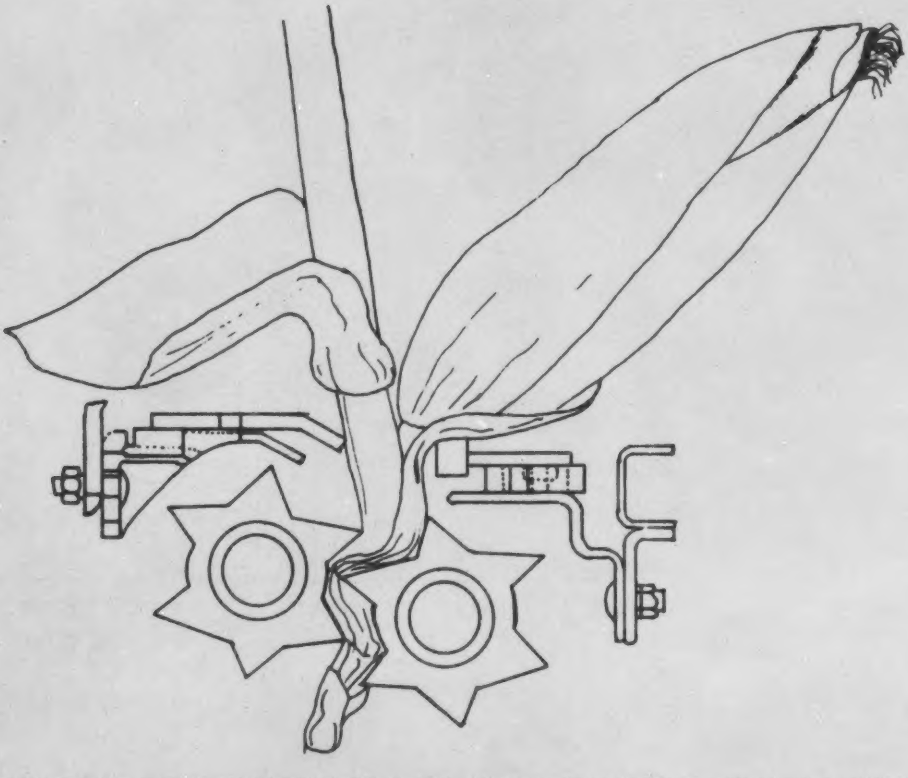


snapping rolls and related parts

1. shield
2. lower bearing
3. outer roll
4. live points
5. bearing housing
6. inner roll
7. lower bearing
8. linkage



WEED KNIVES PREVENT WEEDS AND VINES FROM WINDING AROUND THE ROLLS



SNAPPING OR STRIPPING PLATES AID IN SNAPPING OFF THE EARS

Assignment Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Corn Pickers

TOPIC: Husking, Cleaning, and Shelling Mechanisms

OBJECTIVE: To develop an understanding of the types, parts, and operation of husking, cleaning, and shelling mechanisms.

REFERENCES:
1. Machines for Power Farming, pp. 492-510
2. Farm Machinery and Equipment, pp. 343-353
3. Information Sheet, "Husking, Cleaning, and Shelling Mechanisms"

QUESTIONS OR ACTIVITIES:

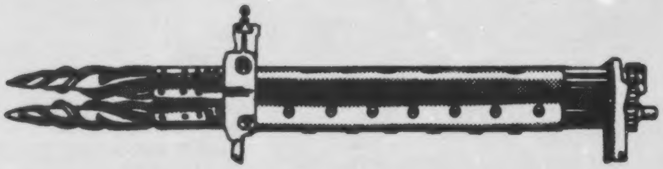
1. List the two distinct types of husking mechanisms.
2. Explain the differences between the two types of husking.
3. Explain how the husking mechanism operates.
4. List the major parts of a cleaning mechanism.
5. Give the function of each of the major parts.
6. Explain in detail how the cleaning mechanism operates.
7. List the primary parts of a shelling mechanism.
8. Explain the complete operation of a shelling mechanism.
9. Identify the parts of a shelling unit found in the information sheet.

Information Sheet
on
HUSKING, CLEANING, AND SHELLING MECHANISMS

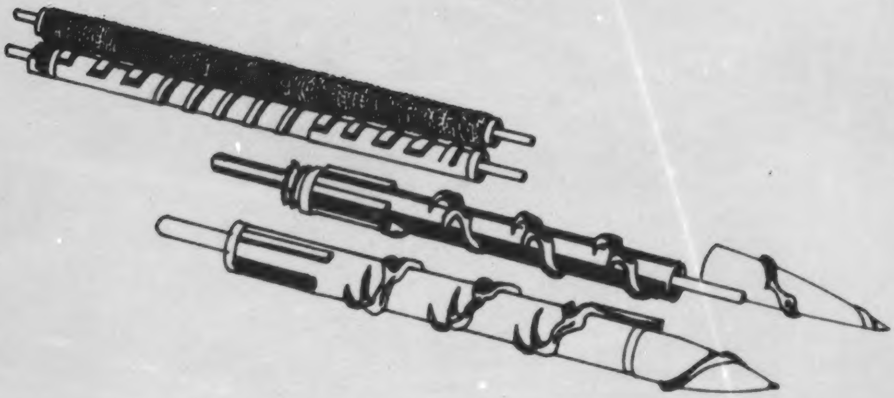
Corn huskers are common components of most corn harvesting machines, with the exception of corn snappers and sweet corn harvesters. These husking mechanisms are of two types. The continuous or combination rolls are a continuation of the snapping rolls; the separate husking rolls have a separate drive and are independent of the snapping rolls. The husking rolls operate in pairs. One roll is usually rubber or rubber-coated, and the rolls rotate toward each other, similar to the action of the snapping rolls. The rolls are corrugated, allowing them to grasp and pull the husks from the ear. The corn ears are held against the husking rolls by a pressure plate, with a minimum of shelling of kernels from the cob.

The cleaning mechanism utilizes a mechanical trash ejector and air blasts. Ejecting rolls and augers remove trash and husks from the husking rolls and discharge this to the ground. The air blast from the fan strikes the ears as they leave the rolls. The strength of the air blast can be adjusted as needed to blow off loose husks, leaves, pieces of stalk, and other trash.

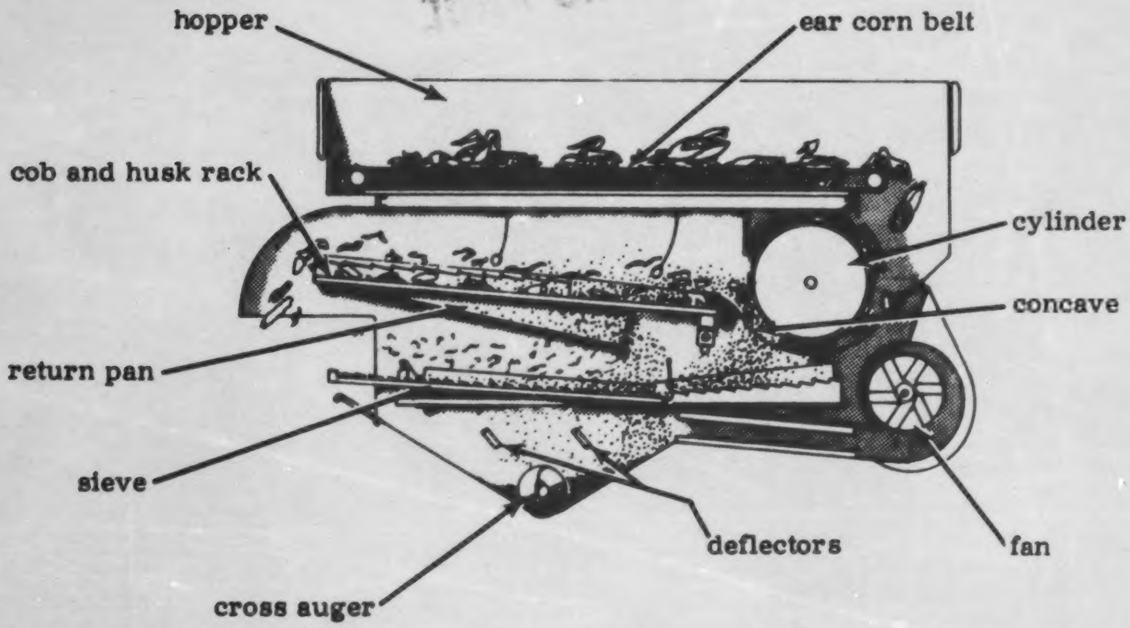
The function of the shelling mechanism is to shell the corn ears as they come from the husking rolls. The shelling mechanism consists of a peg-studded cylinder that rotates inside a cylinder screen. Through tests it has been determined that a 5/8-inch clearance is the most desirable. The shelled corn drops through the holes in the screen onto a set of sieves that agitate. The trash that comes through the cylinder screen is blown away by a blast of air created by a fan located below the cylinder. The shelled corn falls through the sieves into the auger, where it is augered into the wagon. The main parts of the shelling unit are shown on the following sketch.



CONTINUOUS ONE-PIECE
SNAPPING AND HUSKING ROLLS



SEPARATE SNAPPING
AND HUSKING ROLLS


hopper
ear corn belt
cob and husk rack
cylinder
concave
return pan
sieve
deflectors
fan
cross auger

SECTIONAL VIEW OF SHELLING UNIT FOR CORN SHELLER

Assignment Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Cotton Strippers and Pickers

TOPIC: Strippers

OBJECTIVE: To develop an understanding of the cotton stripper and its development. To understand the different types and sizes of strippers, their rate of work, their principal parts, and their operation.

REFERENCES:

1. Machines for Power Farming, pp. 511-519
2. Farm Machinery and Equipment, pp. 355-366
3. Information Sheet, "Strippers"

QUESTIONS OR ACTIVITIES:

1. List the sizes and types of cotton strippers available.
2. Explain the function of a cotton stripper.
3. There are two main types of cotton strippers, based on the mechanism used for the stripping action. Name these two types.
4. Explain the difference between the roll stripper and the finger stripper.
5. List the two basic mechanisms of the cotton stripper.
6. Give the basic function of the two mechanisms.
7. What is the main purpose of a safety clutch?
8. For what is the spring-loaded strip bar used?
9. What is the purpose of the stripper bar?
10. Why is it necessary to adjust the stripper rolls?
11. When is the stalk roll used?
12. When is it not necessary to use the strip bar cross rod?

Information Sheet
on
STRIPPERS

Until a few years ago most of the cotton grown in this country was hand harvested. Due to the cheap labor available, cotton pickers and strippers were not accepted until the war in the early 40's.

Cotton strippers are tractor driven and are either mounted or trailing. The size range for these machines is from one to two rows. They may be operated from 2 to 6 miles per hour and can strip up to 1 bale in 30 minutes. Strippers are designed to harvest stormproof or semi-stormproof varieties. The plants are usually less than 30 inches tall, and the plant populations are high. Because stripping is a once-over operation, harvesting is usually delayed until nearly all the bolls are open.

There are two types of stripping mechanisms found on these machines. The roll stripper employs one or more revolving rolls to strip the cotton from the stalk. The material used in the rolls may be steel, fabric, rubber, or bristle brushes. Steel rolls are the most common. To prevent these rollers from pulling the plants out of the ground, another set of rollers, located below the stripper rolls, pulls the plants downward.

The tine-type or finger-type stripper uses closely spaced steel bars to comb the bolls from the plants. A revolving beater above the tines helps strip the cotton from the stalks. This type is not as widely used as the roll type.

Cotton strippers have two basic mechanisms:
a. Gathering
b. Cleaning and conveying

The gathering mechanism lifts and guides the cotton plants into the stripper. Here the bolls are stripped from the plant. The cleaning and conveying mechanism cleans and conveys the cotton. Cleaning is done while the stripped material is being conveyed from the stripping unit to the wagon or basket. Cleaning is done either with open grills or grates or fans, depending on the design. Rubber flights, attached to a heavy rubber belt, carry the cotton to the trailer behind the tractor. Dirt, dust, and loose trash fall through the screened bottom of the side conveyors as well as the center-delivery cross conveyor. This results in cleaner cotton and lower ginning costs.

Most drives on cotton strippers are equipped with a safety clutch. These clutches are set to skip if the machine is overloaded and thereby protect the machine.

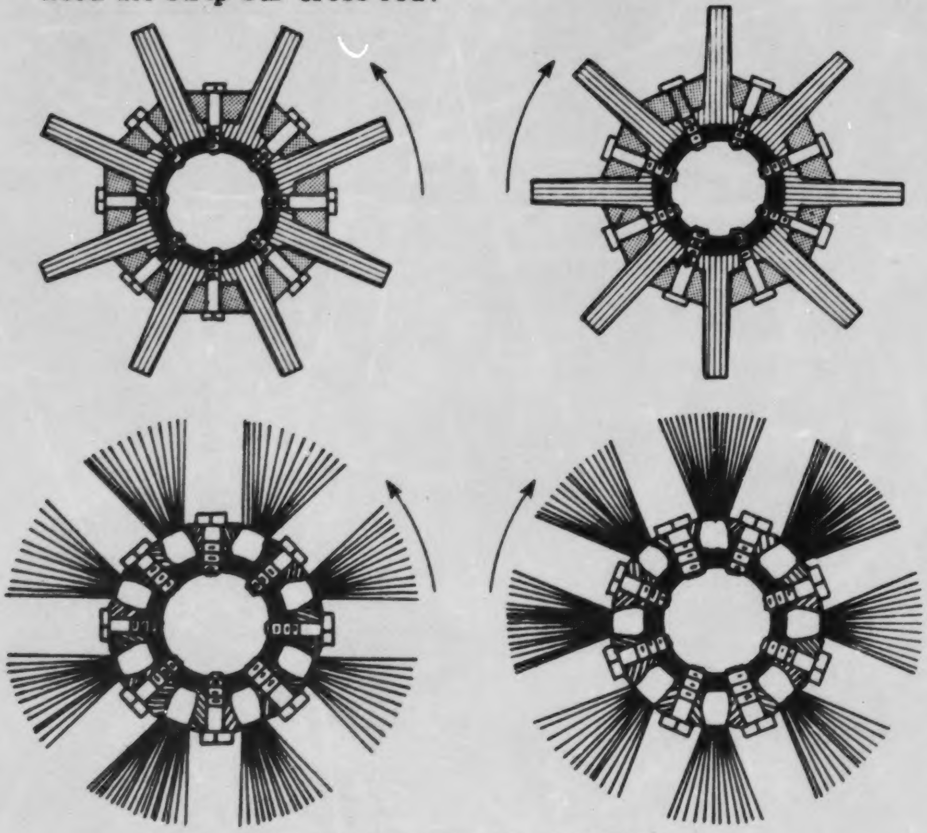
Strippers
(Information Sheet continued)

When selecting a machine for specific needs these factors should be considered.

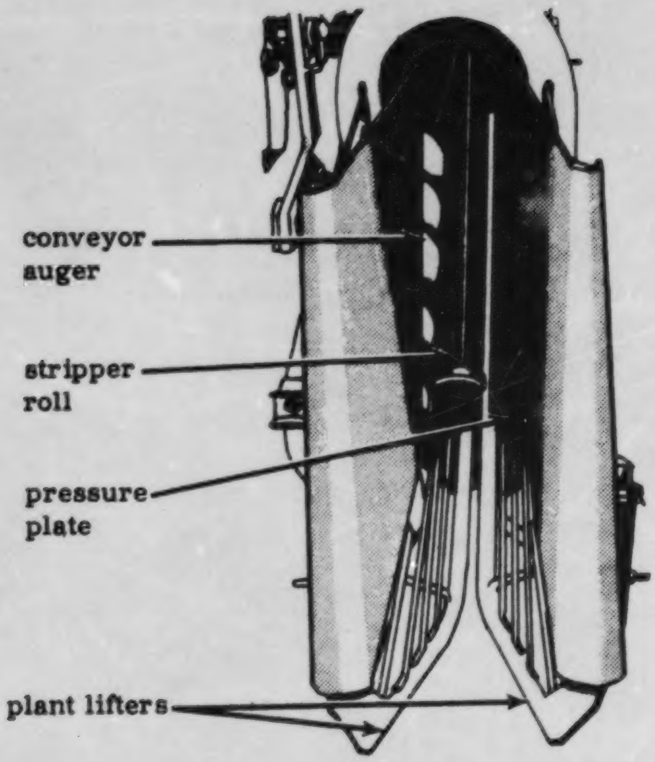
a. Cotton stalks are held against the roll by stripper bars, or if it is a double roll machine the two rows oppose each other. The distance between these is important. The stripper will perform a better job if the clearance between these is adjustable to meet moisture conditions, stem thickness, and plant population. On some machines the stripper bar is spring loaded and adjusts automatically.

b. Machines should be equipped with a stalk roll if they are to be operated in tall, rank cotton or if the root systems are poorly developed.

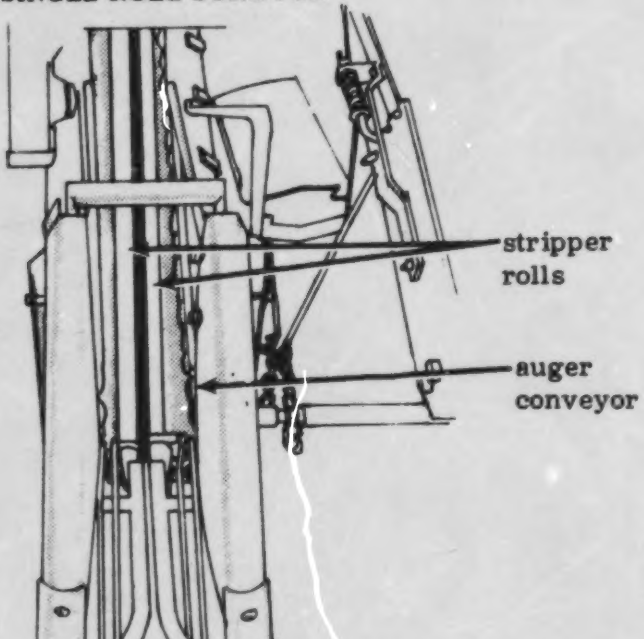
c. Strippers that are equipped with gauge wheels or gauge rods do not need the strip bar cross rod.



CROSS SECTION OF BRUSH AND
RUBBER-STRIP-PADDLE COTTON-STRIPPING ROLLS


conveyor auger
stripper roll
pressure plate
plant lifters

SINGLE ROLL STRIPPER


stripper rolls
auger conveyor
plant lifters

DOUBLE ROLL STRIPPER

Assignment Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Cotton Strippers and Pickers

TOPIC: Pickers

OBJECTIVE: To develop an understanding of the different types, sizes, rate of work, principal parts, and operation of pickers.

REFERENCES:

1. Machines for Power Farming, pp. 519-530
2. Farm Machinery and Equipment, pp. 366-381
3. Information Sheet, "Pickers"

QUESTIONS OR ACTIVITIES:

1. Name the four ways of classifying cotton picking machines.
2. Cotton pickers can be classified according to the way they are mounted. What are the two ways in which pickers may be mounted?
3. How many rows will a cotton picker harvest at once?
4. List the two heights of picking drums available.
5. What are the two types of spindles used on cotton pickers?
6. List the principal parts of a cotton picker and explain the function of each.

Information Sheet on PICKERS

Cotton pickers operate much differently from strippers and are therefore treated as a separate subject.

Cotton pickers are classified in four ways. First is the method of mounting. They may be mounted as a separate attachment or the machine may be built as a self-propelled unit. Second, these machines may be either one or two row. Third, they are classified by the height of the picking drums. A picking drum with 20 spindles per bar is suitable for tall cotton, while 14 spindles per bar is used for shorter cotton. The fourth classification used is the type of spindles. The machines may be equipped with tapered or straight spindles. The tapered spindles have 3 or 4 rows of machine-cut teeth and are moistened only for cleaning purposes. The straight spindles may be only slightly roughened and are moistened both for cleaning and to aid the bolls in adhering to the spindle.

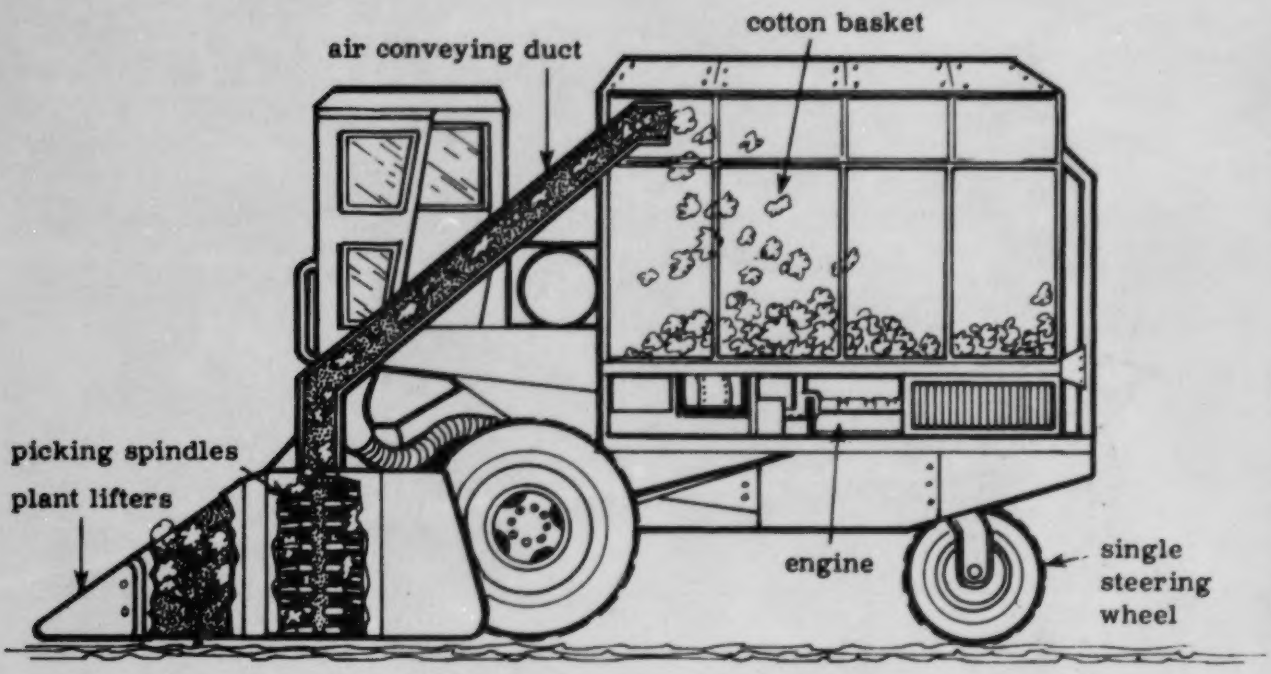
There are two general arrangements for mounting and operating cotton spindles:

1. The drum type is the most common and uses tapered spindles.
2. The chain belt is less popular and uses straight spindles.

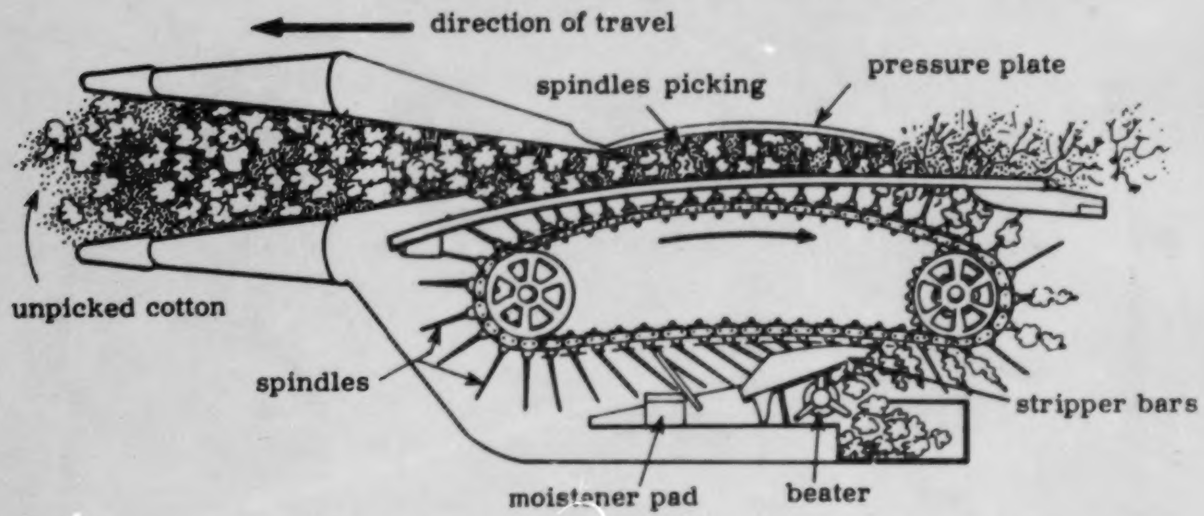
The cotton picker, like many other machines, combines several units to perform a job. The first of these is the gathering unit. It consists of stalk lifters, spring fingers, and grid bars. These move the cotton stalks into the picking area. The picking unit consists of hundreds of spindles mounted on spindle bars. The spindles rotate at 90 degrees to the direction of travel as they remove the seed cotton from the stalk. A machine may have 14 or 20 spindles per bar. The bars are mounted on two drums, one on each side of the row. As the spindles rotate, they entangle the seed cotton and extract it from the stalk. The doffer and cleaning unit is the next in the process. The doffers remove the cotton from the tapered spindles after they leave the plant. The rubber face doffers drop the seed cotton so that it can be picked up by the air from the conveyor. Cotton from straight spindles is removed by a stripper bar as the spindle passes the bar. Doffers do not clean the spindles; therefore, the picking unit is equipped with moisture carrying tubes that deliver the water to rubber cleaning pads. These clean the spindles of dirt, plant sap, and other materials.

In the conveyor unit, cotton is moved to the carrying baskets by a fan that draws cotton from the drum through conveyor pipes. Dirt and trash are extracted from the cotton through grates by the air blast before it reaches the carrying basket.

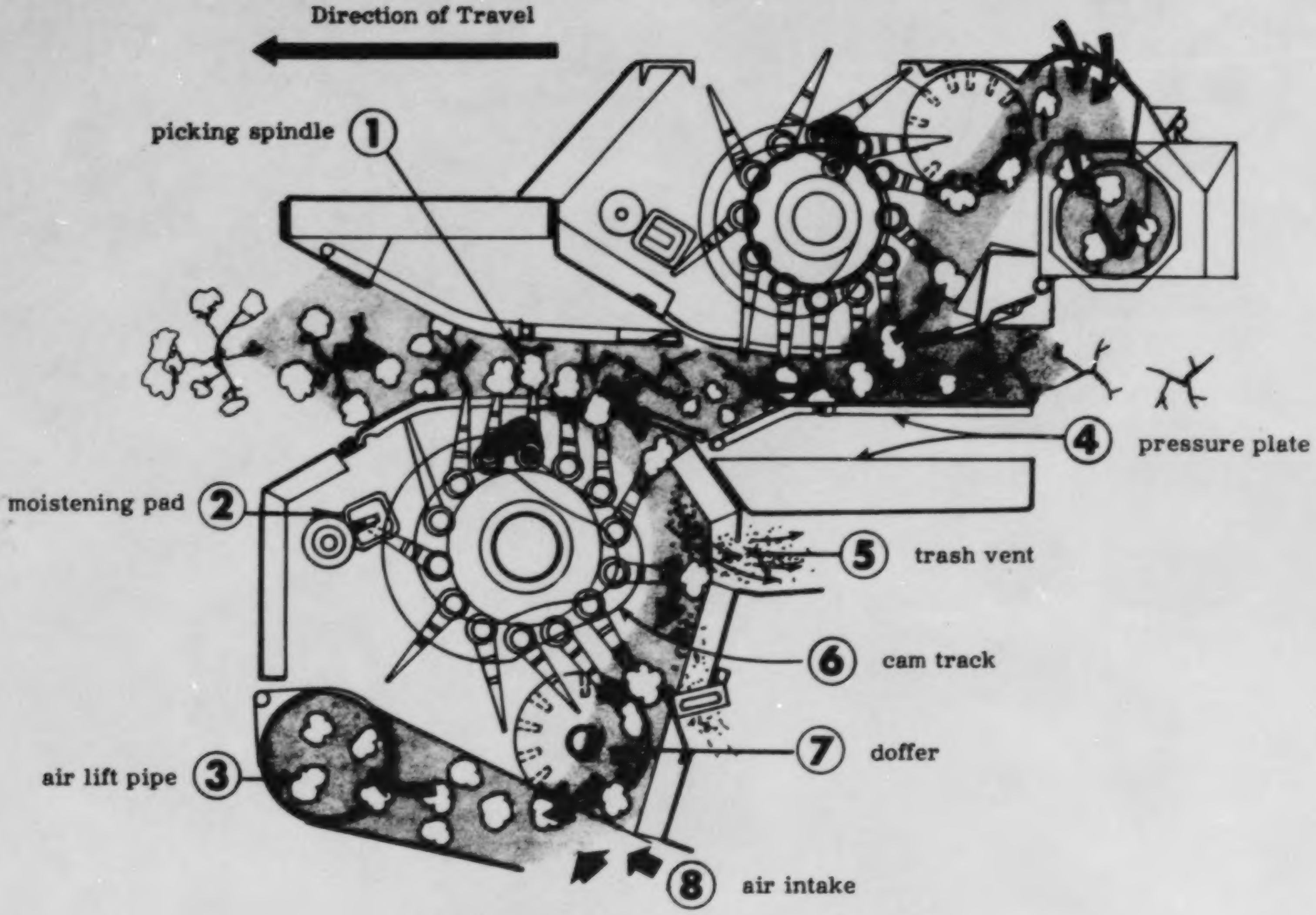
Mechanical cotton pickers have been a great advantage to the American farmer. With the cost of labor going up and dependable farm labor hard to find, cotton pickers have become irreplaceable. A single-row machine, under favorable conditions, may pick as fast as 40 hand workers.


air conveying duct
cotton basket
picking spindles
plant lifters
engine
single steering wheel

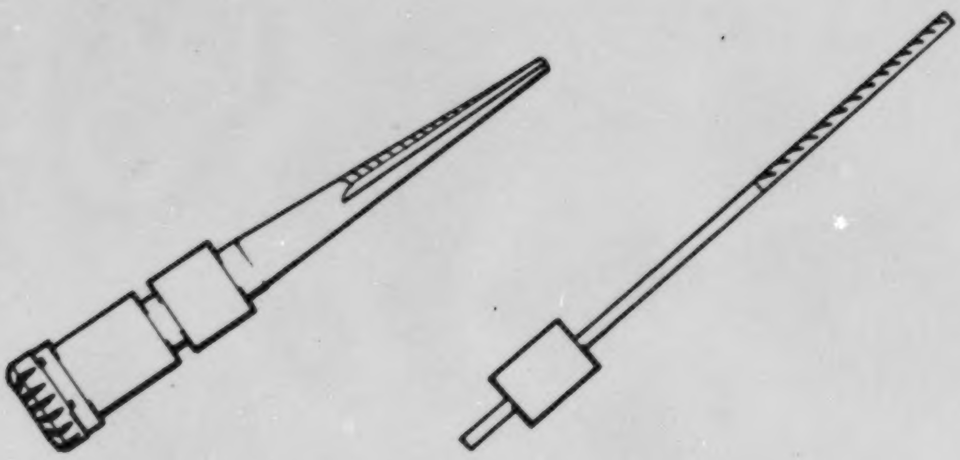
SHOWING THE FLOW OF COTTON FROM
THE PICKING SPINDLES TO THE BASKET


direction of travel
spindles picking
pressure plate
unpicked cotton
spindles
stripper bars
moistener pad
beater

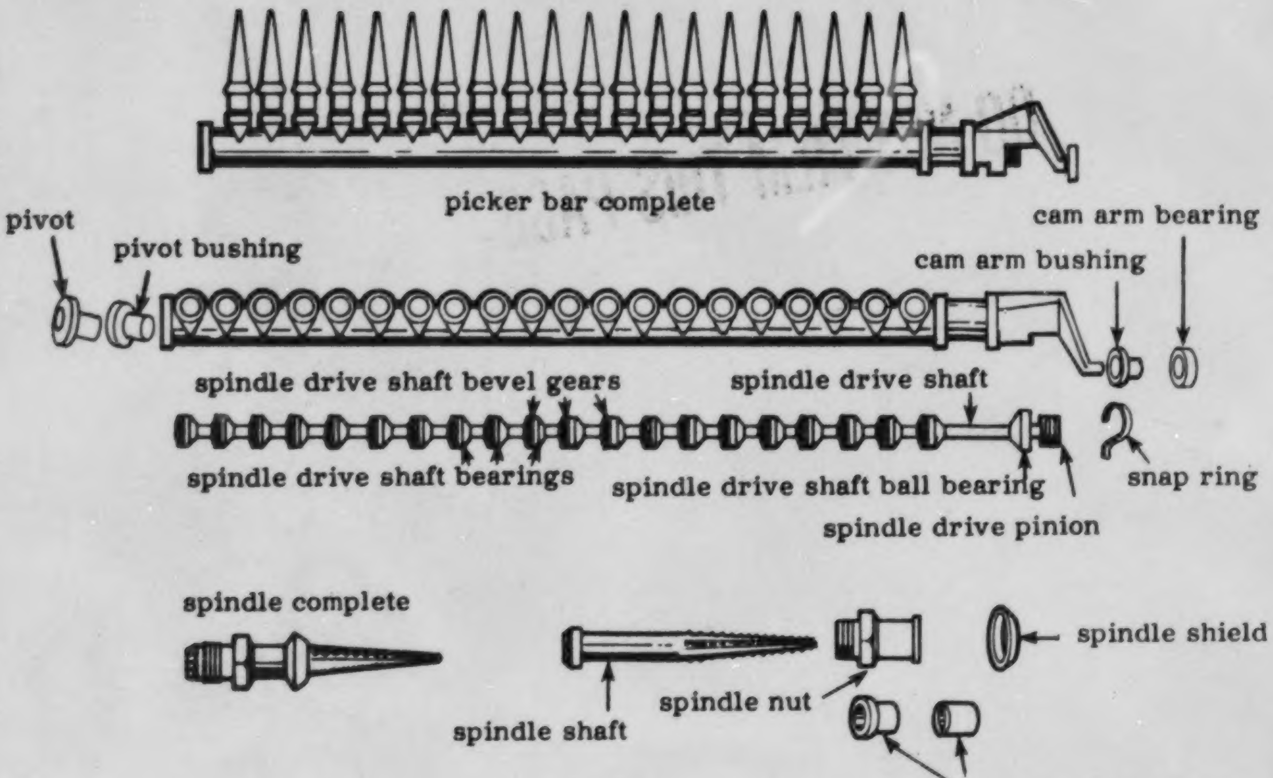
COTTON SPINDLES MOUNTED ON A BELT
AND PICKING FROM ONE SIDE OF THE ROW


Direction of Travel
picking spindle ①
moistening pad ②
air lift pipe ③
④ pressure plate
⑤ trash vent
⑥ cam track
⑦ doffer
⑧ air intake

OVERHEAD PLAN VIEW OF THE OPERATIONAL ACTION OF
COTTON-PICKER SPINDLES PICKING FROM EACH SIDE OF THE ROW



TYPES OF COTTON-PICKING SPINDLES


picker bar complete
pivot
pivot bushing
cam arm bearing
cam arm bushing
spindle drive shaft bevel gears
spindle drive shaft
spindle drive shaft bearings
spindle drive shaft ball bearing
snap ring
spindle drive pinion
spindle complete
spindle shield
spindle shaft
spindle nut
spindle nut bushings

PICKER BAR WITH SPINDLES

Assignment Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Hay and Forage Equipment

TOPIC: Mowers

OBJECTIVE: To develop an understanding of the types, sizes, major parts, and operation of mowers.

REFERENCES:

1. Machines for Power Farming, pp. 387-409
2. Farm Machinery and Equipment, pp. 289-300
3. Information Sheet, "Mowers"

QUESTIONS OR ACTIVITIES:

1. What are the three main types of mowers?
2. List the major parts of the mower.
3. What is the function of the frame?
4. Name the parts of the cutter bar assembly.
5. Name the parts of the mower drive.
6. Explain how a tractor mounted and a trailing draw bar type of mower receive power.

VOCABULARY: The following key words or terms have been used in this assignment and should now be a part of your vocabulary. Explain or define each.

Dragbar
Sections
Pitman
Yoke
Guard
Swath or grass board
Knife head
Ledger plate
Knife bar
Wear plate

Information Sheet
on
MOWERS

The mowers discussed in this topic are designed to cut forage crops not grown in rows. These mowers are most often used for cutting crops such as hay. They are also used for cutting tall growth and weeds from pastures.

There are three main types of mowers based on the method of mounting. The trailing or semi-mounted mower can be used on almost any type of tractor. This mower is easily attached and allows the cutter bar to follow the contour of the ground. Integral rear-mounted mowers are attached directly to the tractor. The side- or center-mounted mower is the easiest to watch but is also the most difficult to attach.

All tractor-mounted mowers need some protection in case the cutter bar strikes an obstruction. This protection varies from make to make, but some of the methods are:

a. Spring-controlled latch
b. Clutch release
c. Shear pin
d. Engine shut-off

Mowers consist of three main parts:

1. Frame - supports the drive and cutter bar mechanism.
2. Cutter bar assembly - does the actual cutting.
3. Mower drive - transmits power from the tractor to the cutter bar.

The frame of these mowers is usually welded because of the vibration. The frame consists of a dragbar that extends from the tractor to the yoke. The yoke is the casting to which the cutter bar is hinged. A pullbar is mounted to the front of the yoke and is attached to the front of the frame. These three components hold the cutter bar in the proper mowing position. The dragbar and the pullbar are hinged to allow the yoke and cutter bar to be raised. This can be done by a hand lever or by the tractor's hydraulic system.

The cutterbar assembly consists of:

a. Knife
b. Knife bar
c. Sections
d. Guards
e. Knife clips
f. Outer shoe
g. Inner shoe
h. Knife head
i. Wear plates
j. Ledger plates

The knife is made up of the knife bar, sections, rivets, and the knife head. The sections and knife head are riveted to the bar. The sections, working against the ledger plates, do the actual cutting. They are triangular in shape with

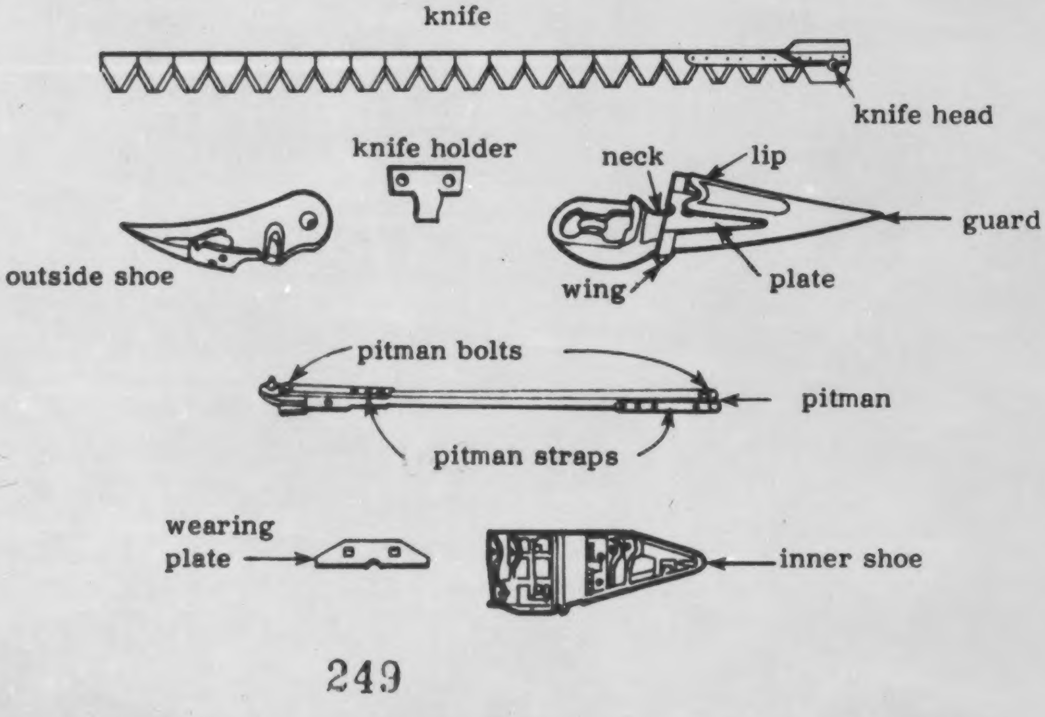
Mowers
(Information Sheet continued)

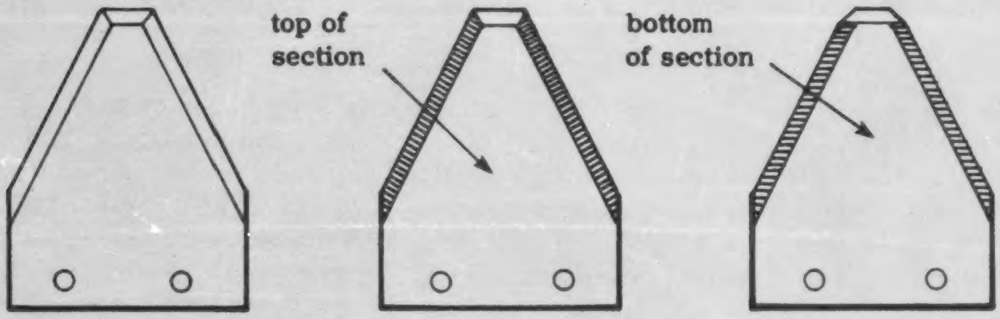
60 degree corners. They may be smooth edge, top serrated, or bottom serrated. The knife bar may be from five to nine feet in length and is made of cold rolled steel. The knife head has a round ball or pin and receives the power from the pitman. Guards help hold the forage during cutting and also protect the sections. Ledger plates are riveted to the guards and form the bottom shearing surface. Knife clips hold the knife in the proper place and prevent it from jumping out. Wear plates keep the sections down on the ledger plates. The inner and outer shoes maintain the proper height of the cutter bar. The cutter bar is about 1/2 inch thick and is tapered toward the end to reduce weight. Most cutter bars are equipped with a swath or grass board mounted on the outer end. This pulls the hay to the side so the tractor wheel will have a clear path.

The knife is driven by the engine through the mower drive assembly. The pitman is like a connecting rod in an engine. It is connected to a flywheel by a crankpin or wrist pin. Together the pitman and flywheel convert the rotary motion of the PTO into straight-in-line motion. The pitman is connected to the wrist pin by the pitman box. This is a bearing and its holder. The bearings vary in type, but non-friction bearings are considered best.

Mowers receive their power from the PTO in various ways. Usually a pulley and V-belt are used to drive the flywheel, though some models may be equipped with a gear, chain, or hydraulic assembly.

VARIOUS PARTS OF A CUTTER BAR WITH KNIFE AND PITMAN



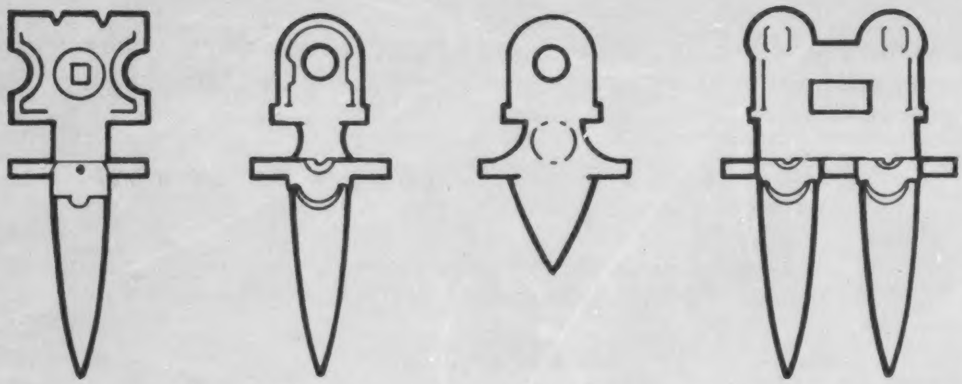

top of
section
bottom
of section

Smooth

Top-Serrated

Bottom-Serrated

COMMON TYPES OF KNIFE SECTIONS



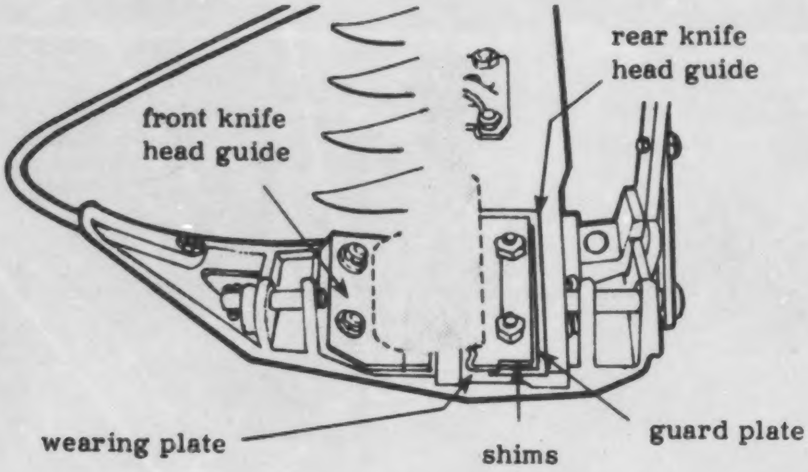
Rock
Guard

Regular
Guard

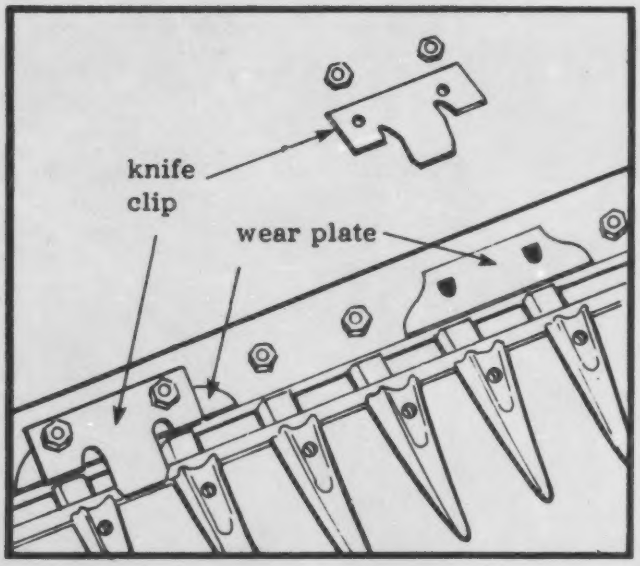
Lipless
Guard

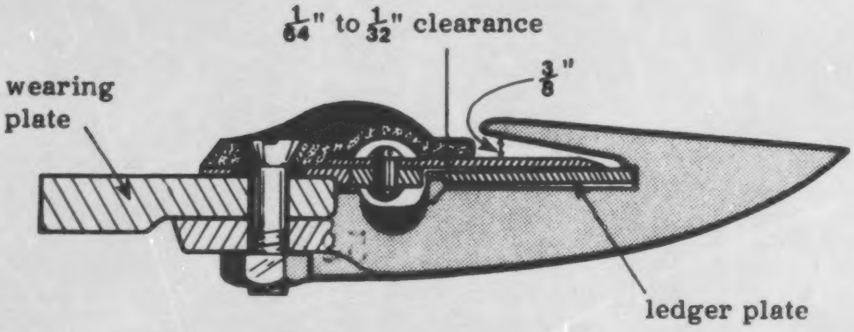
Two Tined
Guard

MAJOR TYPES OF GUARDS


rear knife
head guide
front knife
head guide
wearing plate
shims
guard plate

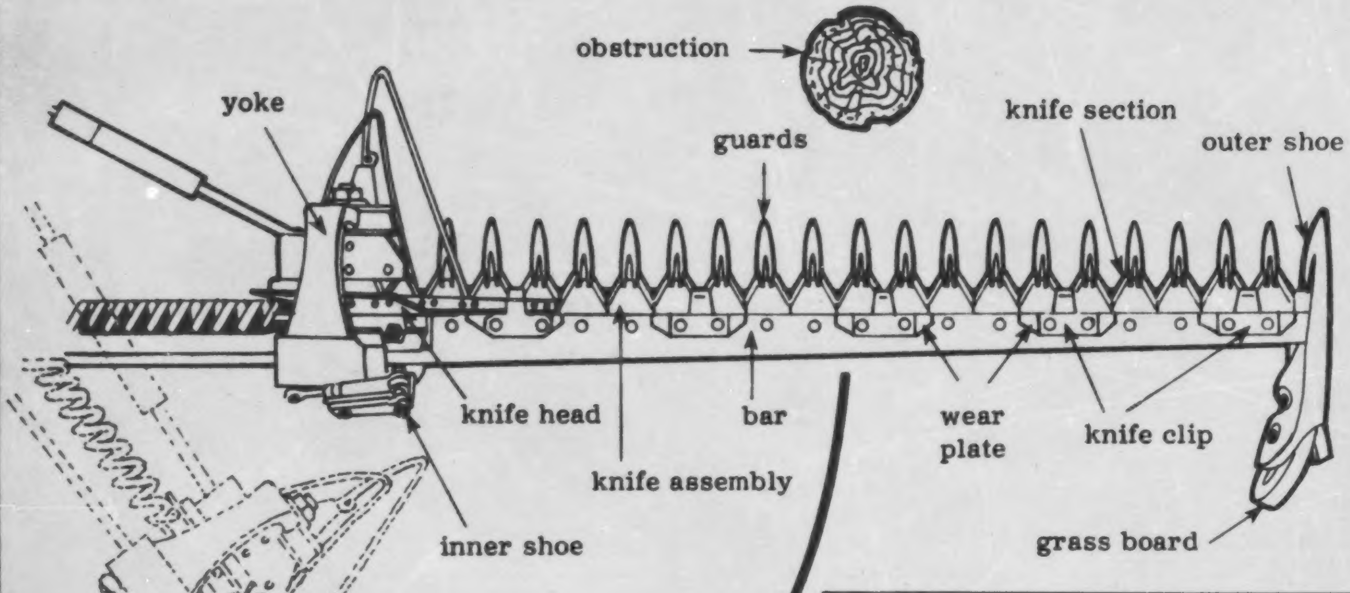
KNIFE-HEAD GUIDE ADJUSTMENT

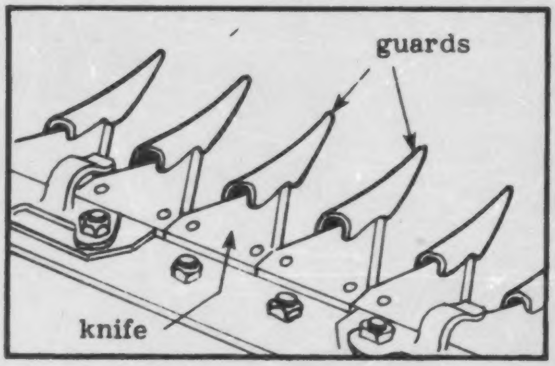

knife
clip
wear plate


$\frac{1}{64}$" to $\frac{1}{32}$" clearance
$\frac{3}{8}$"
wearing
plate
ledger plate

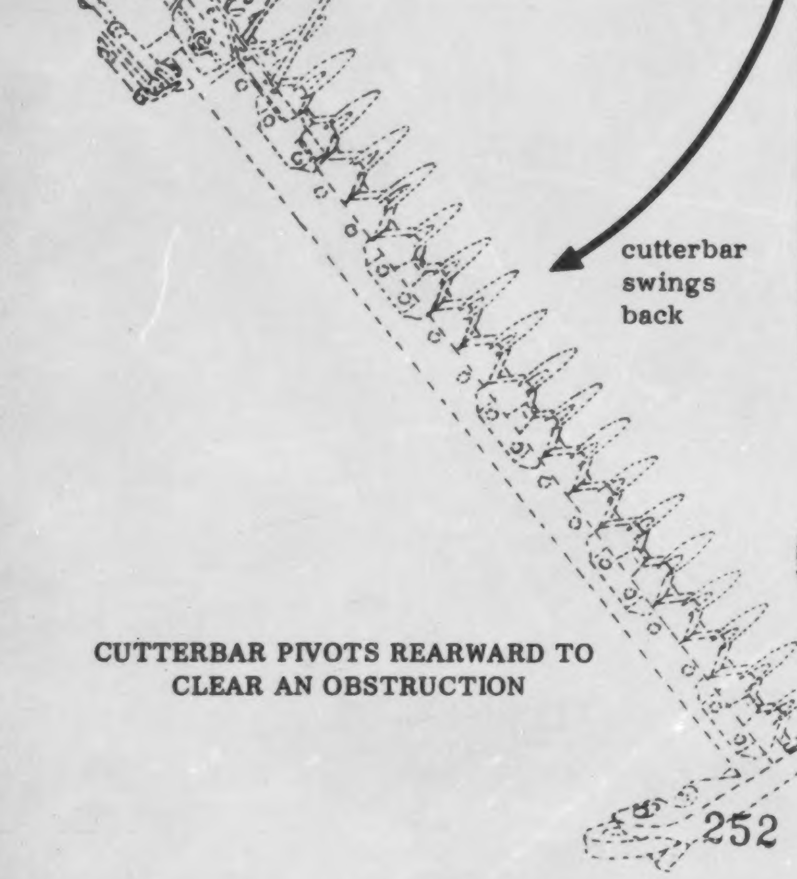
A TYPICAL MOWER GUARD

BASIC CUTTERBAR COMPONENTS

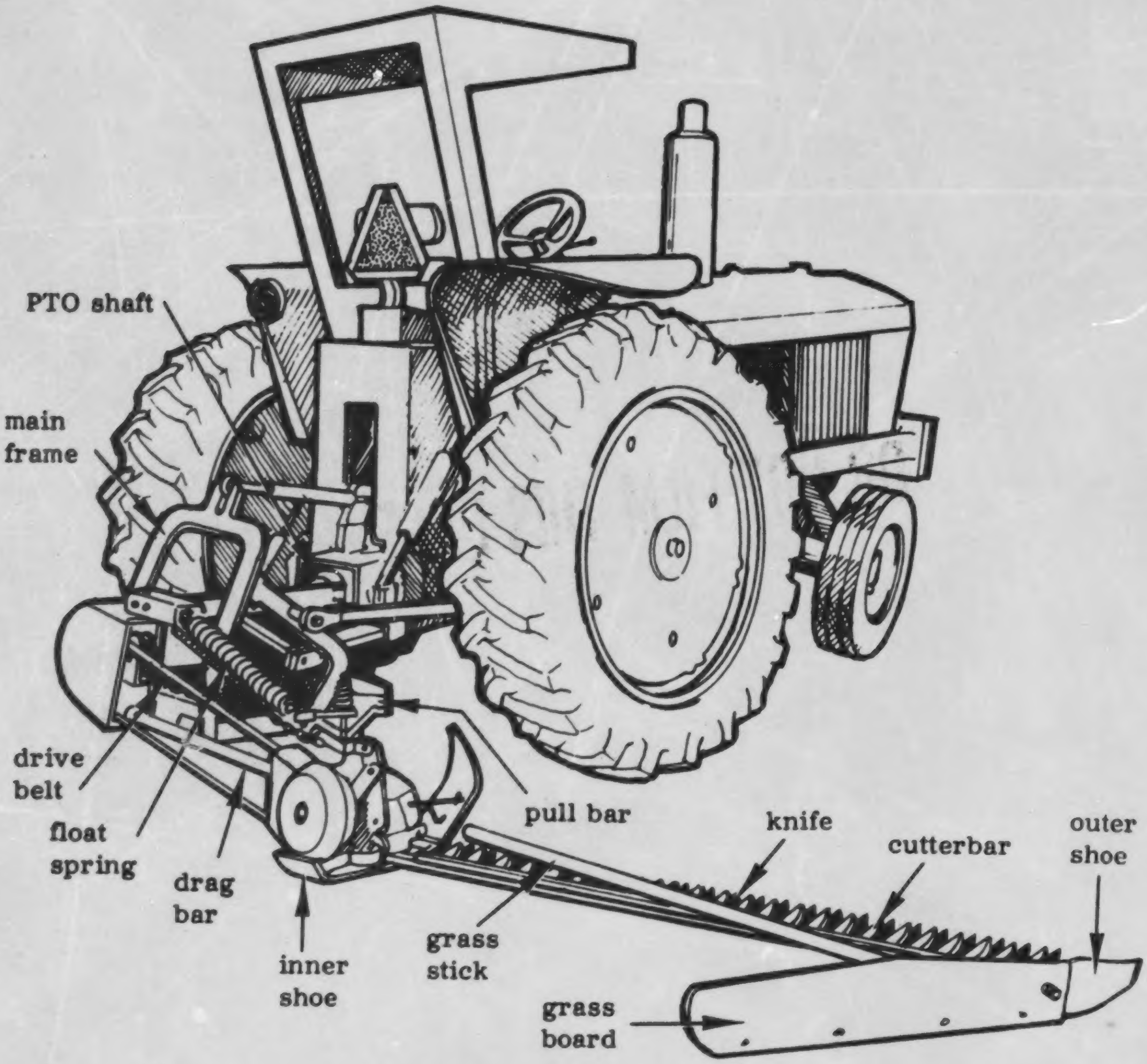

obstruction
yoke
guards
knife section
outer shoe
knife head
bar
wear plate
knife clip
knife assembly
inner shoe
grass board


guards
knife

GUARDS PROTECT KNIFE SECTIONS


cutterbar swings back

CUTTERBAR PIVOTS REARWARD TO CLEAR AN OBSTRUCTION


PTO shaft
main frame
drive belt
float spring
drag bar
inner shoe
grass stick
pull bar
knife
cutterbar
outer shoe
grass board

PRIMARY MOWER COMPONENTS

Assignment Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Hay and Forage Equipment

TOPIC: Hay Rakes

OBJECTIVE: To develop an understanding of the types, sizes, major parts, and operation of rakes.

REFERENCES:

1. Machines for Power Farming, pp. 410-421
2. Farm Machinery and Equipment, pp. 302-306
3. Information Sheet, "Hay Rakes"

QUESTIONS OR ACTIVITIES:

1. Name the three different classifications of hay rakes.
2. What are the four types of side-delivery rakes available?
3. Give the function of the side-delivery rake.
4. What are the major parts of a side-delivery rake?
5. Name the parts of the reel assembly on a side-delivery rake.
6. Give the five methods of adjusting the reel and basket.
7. What are the two main types of drives available on side-delivery rakes?

Information Sheet
on
HAY RAKES

There are three types of hay rakes. The dump rake was first developed as a horse drawn implement. The sweep rake is used for stacking hay or for moving it short distances. The side-delivery rake was developed when farmers became dissatisfied with the scattered windrows of the dump rake. Side-delivery rakes are by far the most popular type used today and come in four different types:

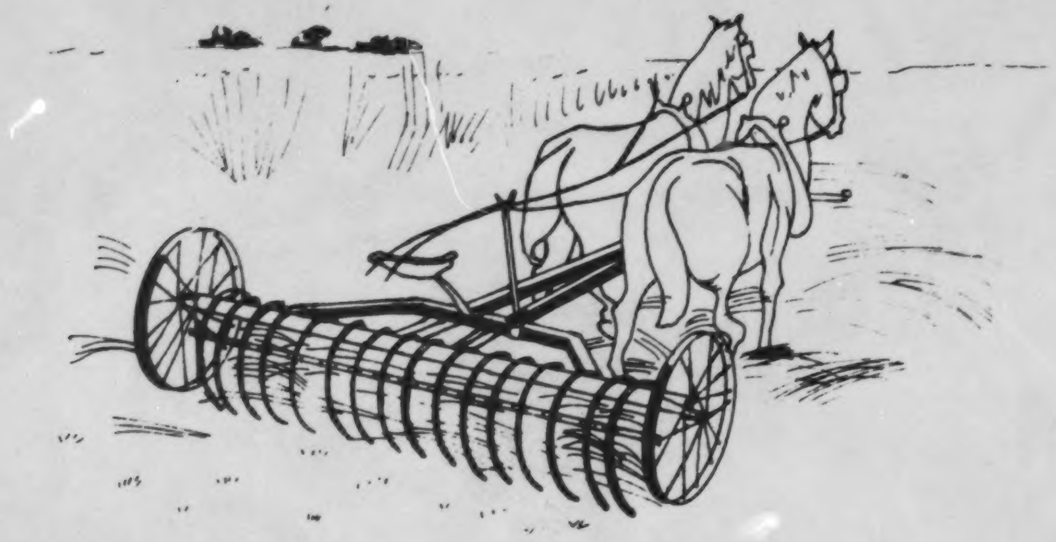
a. Cylindrical - reel
b. Parallel - bar
c. Side - stroke reel
d. Finger - wheel

One of the most critical points of hay making is the curing. With proper use of a hay rake, the high nutrient level of the crop may be maintained. The function of the side-delivery rake is to lift the hay from the swath and place it in a loose, fluffy windrow with the green leaves inside, protected from the sun's rays.

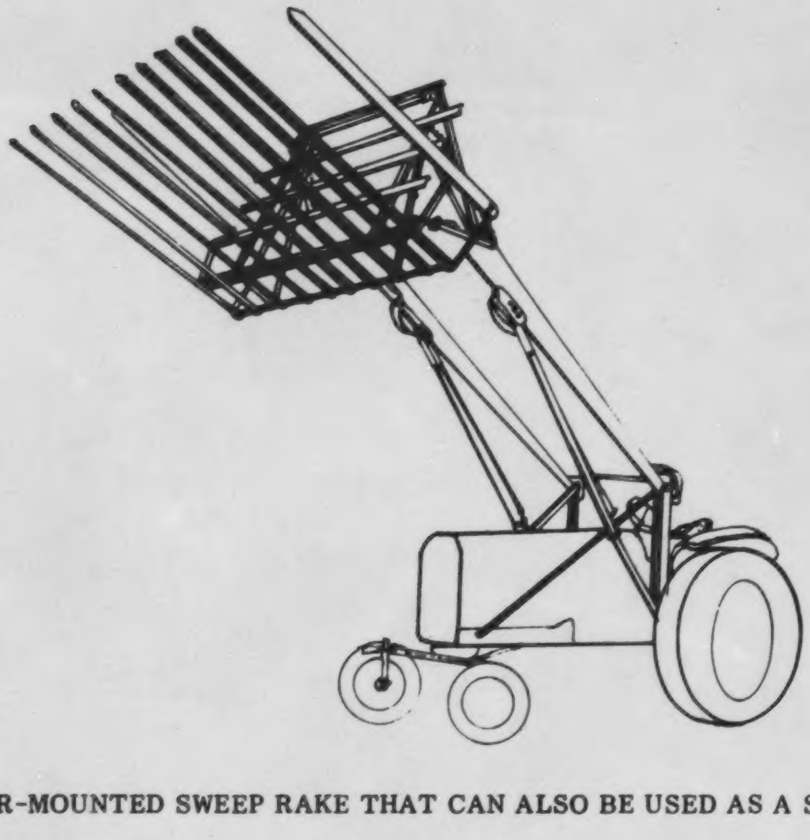
Side-delivery rakes are made up of three major parts. The reel assembly consists of shafts, bars, teeth, spiders, bearings, and special bar rotating devices. Reel assembly components may vary with the type of rake. The frame is the second major part. Frames may be either heavy or light duty depending on the demand of the farm. The drive mechanism may be either of two different types. The two main types of drives are the PTO and the traction drive. The traction drive may use chains and sprockets or gears to drive the reel and may be driven by the front or rear wheels.

Reels and baskets may be adjusted to meet various conditions. The type of adjustment depends on the rake itself. Some models have levers near the tractor to raise and lower the reel, while others may have hydraulic cylinders for this. Other methods of adjusting the reel and basket are:

a. The rake ends can be adjusted up or down.
b. The basket can be changed in relation to the rake frame.
c. Vertical adjustment of the reel axle shaft may be made at each end of the basket.
d. The basket and reel may be free to float up and down together.
e. The height of the reel and basket may be adjusted with bolts or with the rear caster wheels.

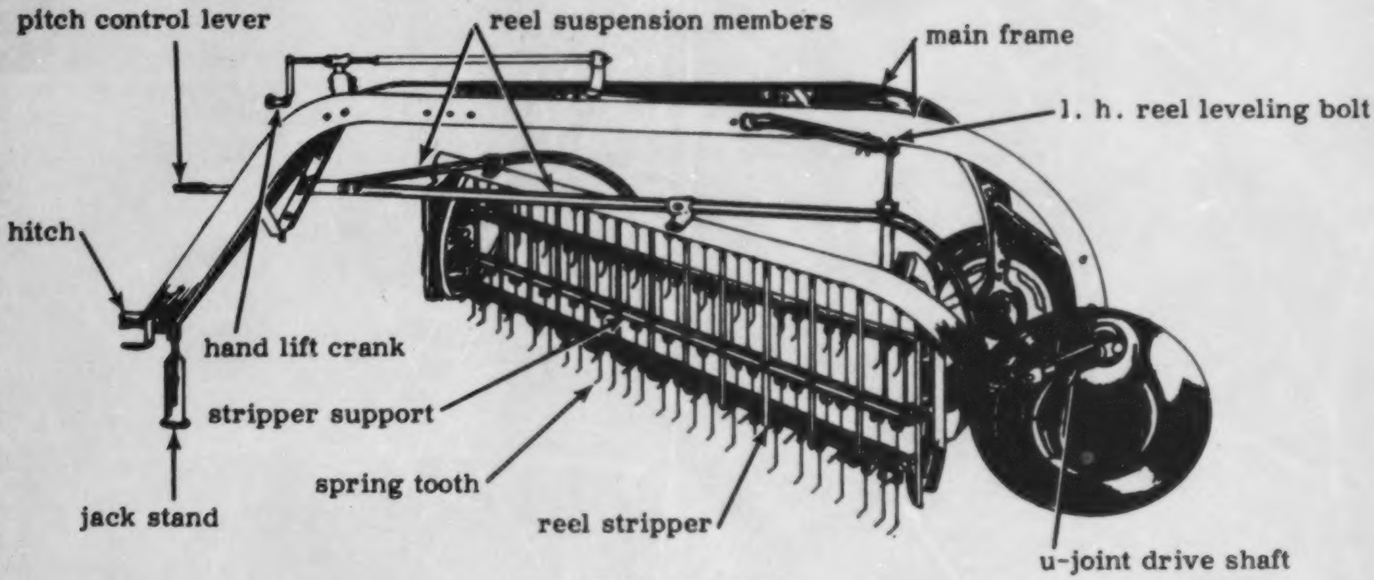


HORSE-POWERED SULKY RAKE WITH HAND DUMP

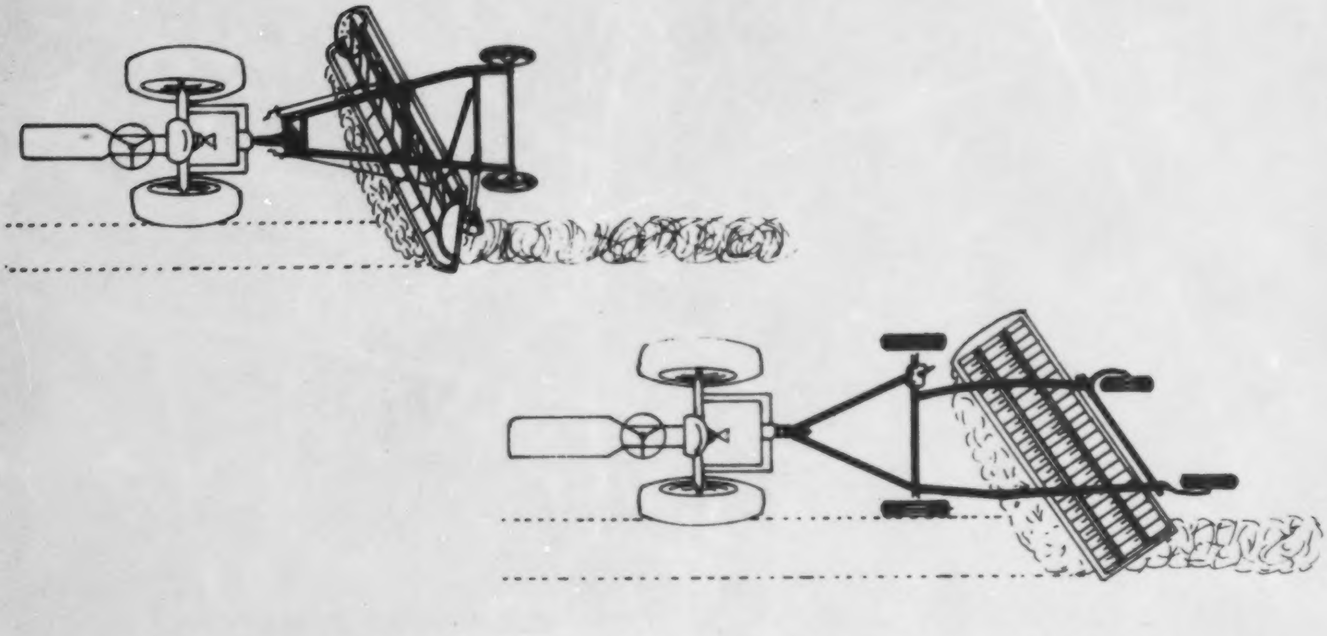


TRACTOR-MOUNTED SWEEP RAKE THAT CAN ALSO BE USED AS A STACKER

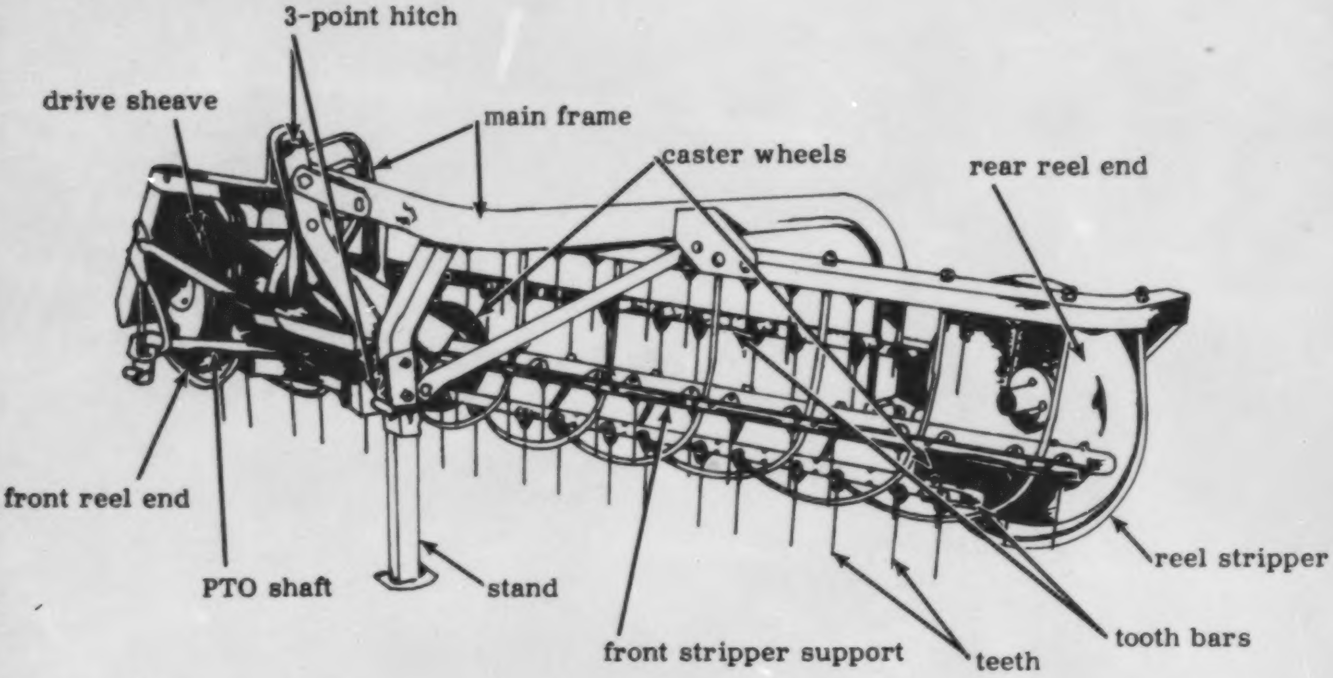
SIDE DELIVERY RAKE


pitch control lever
reel suspension members
main frame
l. h. reel leveling bolt
hitch
hand lift crank
stripper support
spring tooth
jack stand
reel stripper
u-joint drive shaft

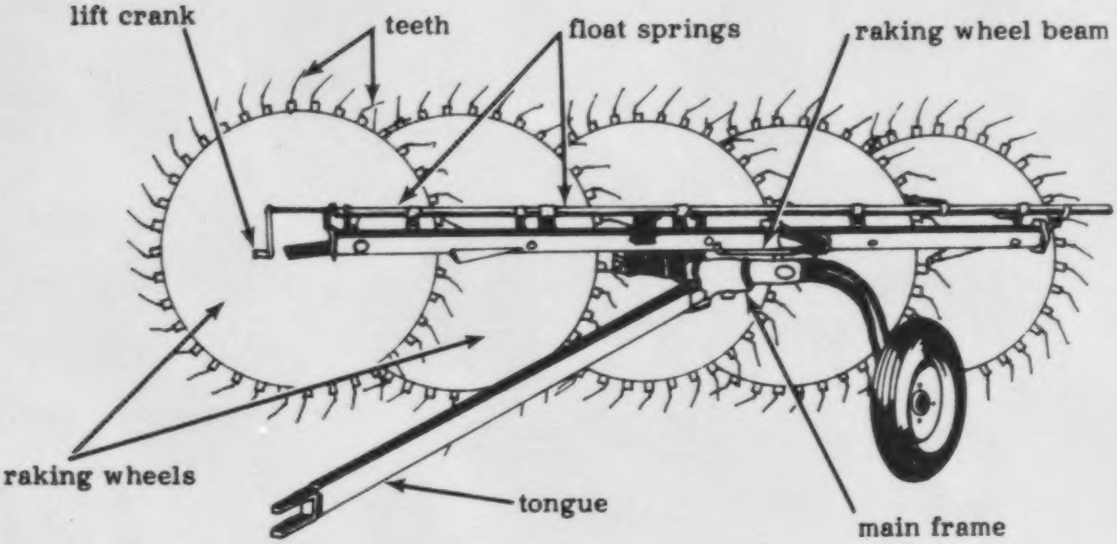
TRACTION DRIVEN



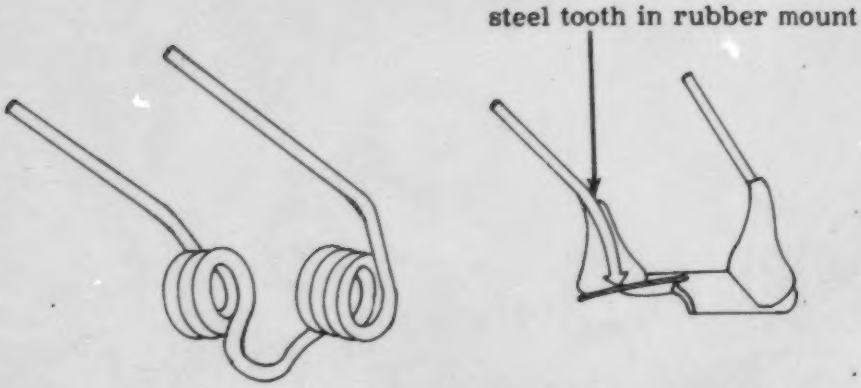
PARALLEL-BAR AT LEFT AND THE CYLINDRICAL-REEL RAKE AT RIGHT


3-point hitch
drive sheave
main frame
caster wheels
rear reel end
front reel end
PTO shaft
stand
reel stripper
tooth bars
front stripper support
teeth

PTO DRIVEN


lift crank
teeth
float springs
raking wheel beam
raking wheels
tongue
main frame

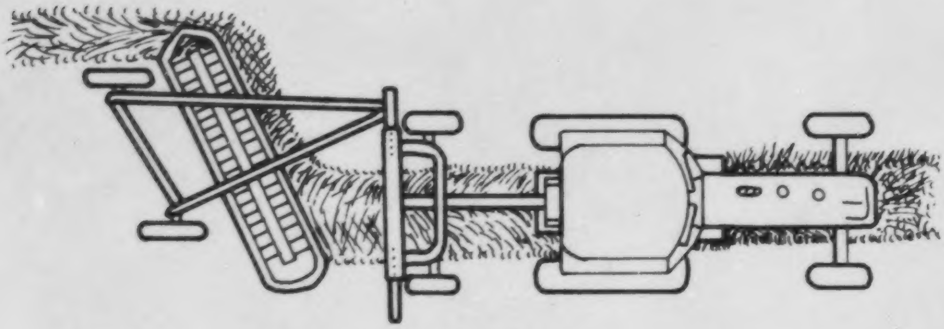
FINGER WHEEL RAKE


steel tooth in rubber mount

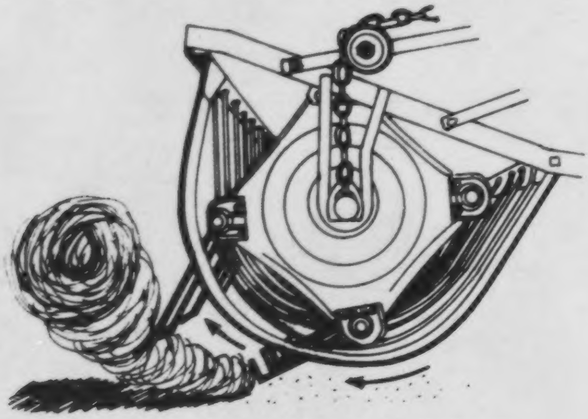
coil spring tooth

rubber-mounted tooth

COIL SPRING AND MOLDED-RUBBER-MOUNTED RAKE TEETH


hay movement

MOVEMENT OF HAY DURING RAKING



SHOWING THE ACTION AND ANGLE OF
THE CYLINDRICAL-REEL HAY RAKE TEETH

Assignment Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Hay and Forage Equipment

TOPIC: Hay Conditioners

OBJECTIVE: To develop an understanding of the advantages of hay conditioning and to understand the different types of conditioners available and how they differ.

REFERENCES:

1. Farm Machinery and Equipment, pp. 300-302
2. Information Sheet, "Hay Conditioners"

QUESTIONS OR ACTIVITIES:

1. Hay is conditioned in three different ways. Name these three ways.
2. Give the advantages of conditioned hay.
3. List the three general types of hay conditioners.
4. Explain how each of the above three machines condition hay.
5. What are the major parts of a hay conditioner?

Information Sheet
on
HAY CONDITIONERS

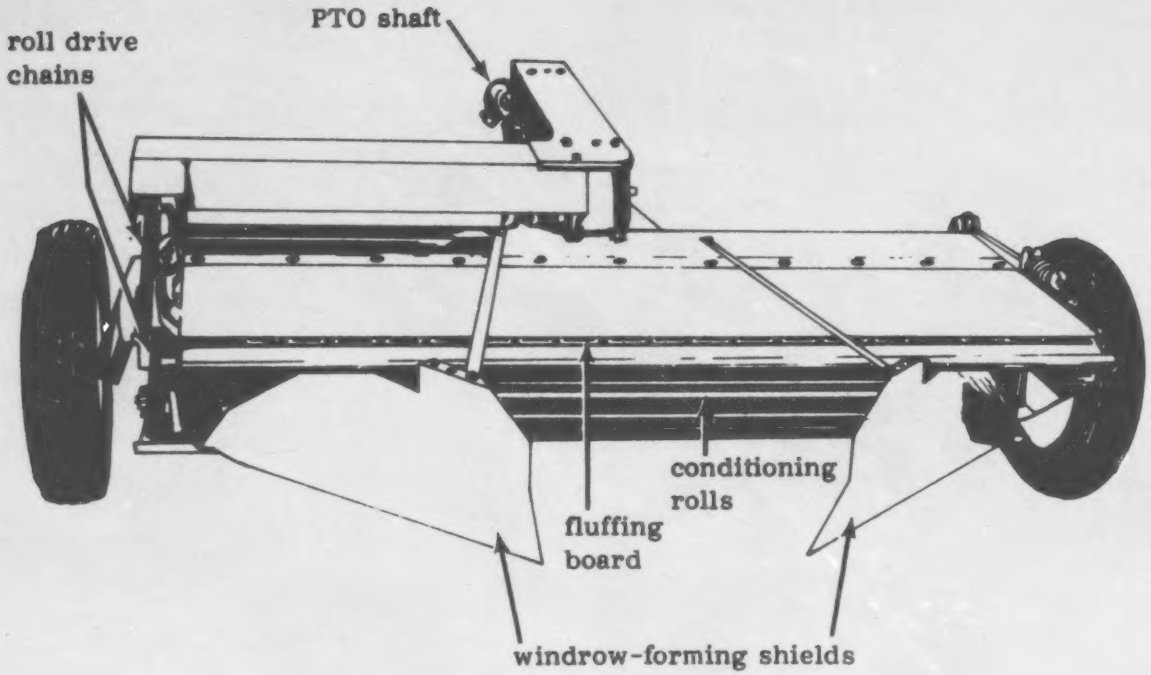
Hay conditioning is becoming a more common practice. As the need for higher quality hay increases, the need for faster methods of curing also increases. Hay conditioners help meet both needs. Some of the advantages of conditioning hay are:

a. Speeds field curing; conditioning can reduce drying time by about 30%.
b. Reduces weather damage.
c. Reduces field losses due to shattering, because curing time and the amount of turning and tedding are reduced.
d. Conserves color and feed value through shorter exposure and less shattering.

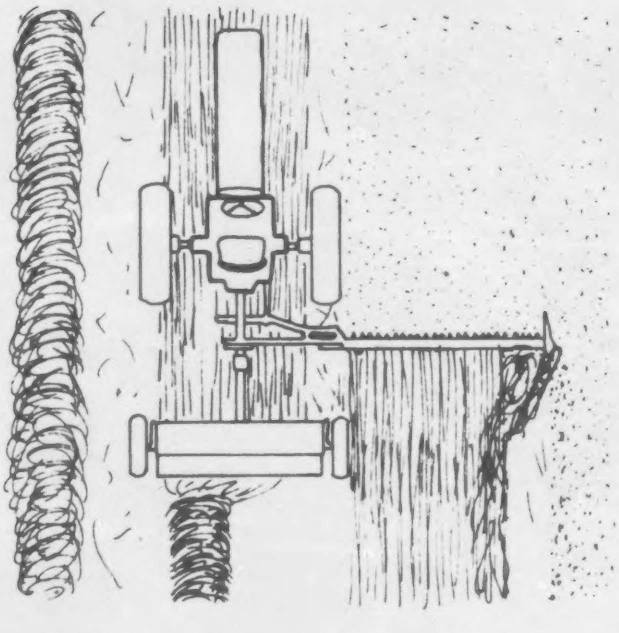
Hay can be conditioned in three ways. Hay can be crushed by using a smooth roll conditioner. This type may use two rubber rolls or a combination of a rubber and a steel roll. The smooth rolls give a continuous crushing action to the hay, leaving no part uncrushed. Most rubber rolls have special grooves to aid in picking up the hay and feeding it between the rolls. Corrugated or crimper rolls perform a crimping action. This conditioner may be equipped with two malleable-iron rolls with tapered flutes that mesh together similar to gear teeth, or with slatted bar rolls. Some models use a fluted or bar roll that presses against a smooth rubber roll. As the hay presses between the rolls, it is bent, crimped, and cracked at intervals, but is not completely crushed. Flailing is the third type of conditioning. The flair-type conditioner is really a hay harvester, but when used as a hay conditioner, the shear bar is removed to reduce the cutting action. The hay is partially chopped by swinging hammers or knives.

Hay conditioner components may vary with the model, but most will have the following major parts:

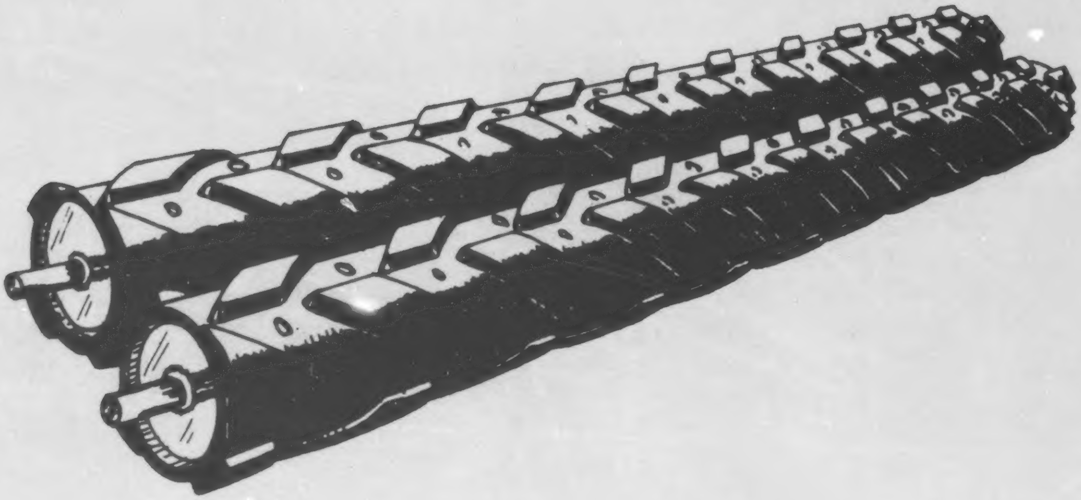
a. Frame
b. PTO drive
c. Shield
d. Cross drive wheels
e. Rollers
f. Drive mechanism
g. Height adjustment
h. Equipment wheels


PTO shaft
roll drive chains
conditioning rolls
fluffing board
windrow-forming shields

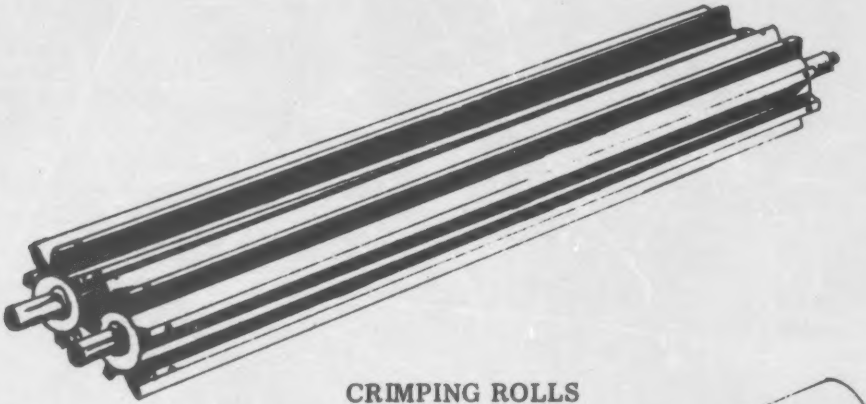
HAY CONDITIONER COMPONENTS



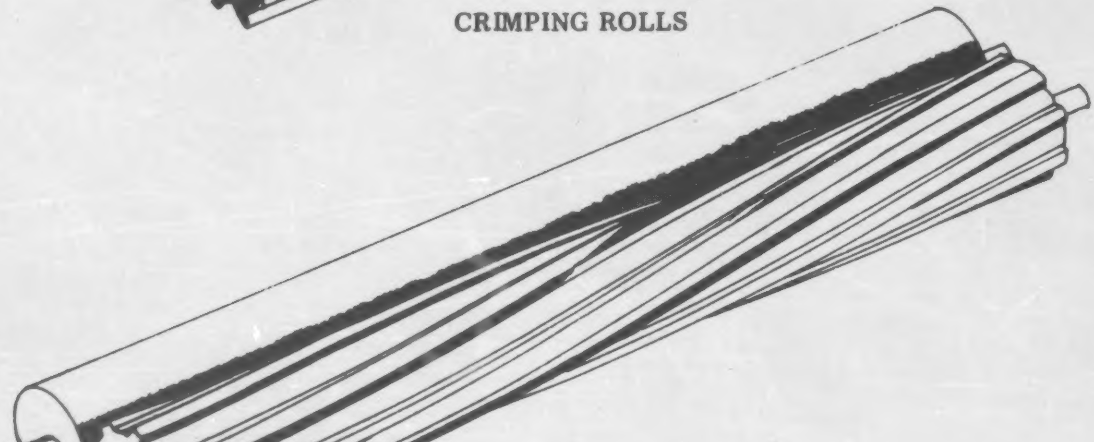
OVERHEAD VIEW OF A SIDE-MOUNTED MOWER AND HAY CONDITIONER



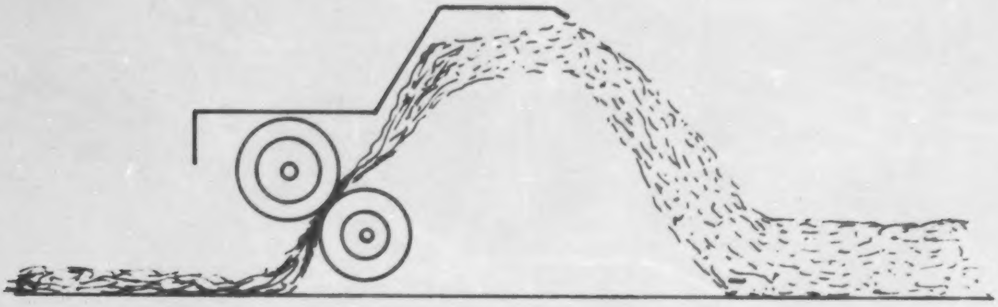
MOLDED RUBBER CRUSHING/CRIMPING ROLLS



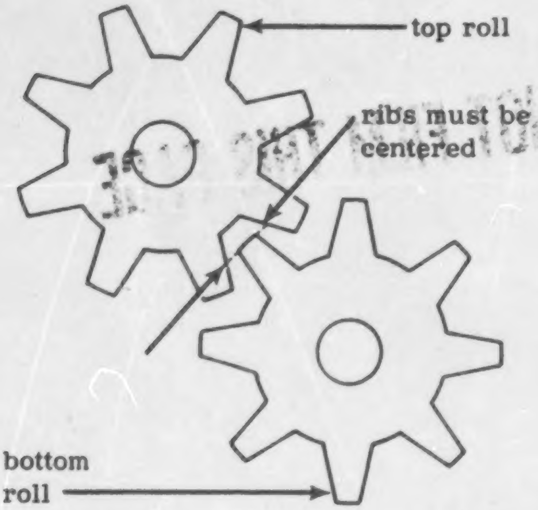
CRIMPING ROLLS



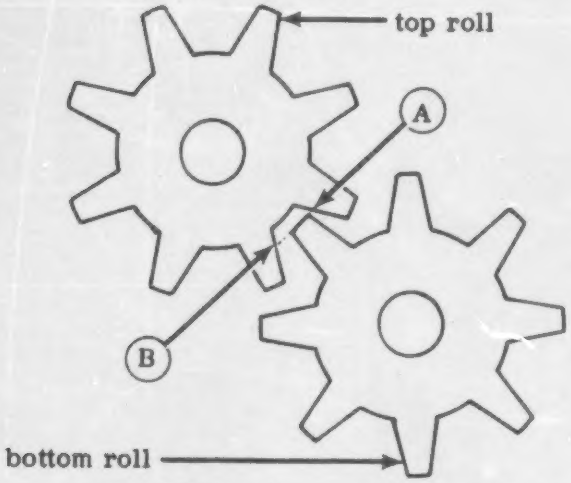
CRUSHING ROLLS



ROLLS DISCHARGE HAY


top roll
ribs must be centered
bottom roll

PROPERLY TIMED CRIMPER ROLLS


top roll
A
B
bottom roll

IMPROPERLY TIMED CRIMPER ROLLS

Assignment Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Hay and Forage Equipment

TOPIC: Windrowers

OBJECTIVE: To develop an understanding of the operation of the windrower.

REFERENCE:
Information Sheet, "Windrowers"

QUESTIONS OR ACTIVITIES:

1. What are the two types of windrowers?
2. List the operations performed by most windrowers.
3. What three implements or operations does the windrower replace?
4. The cutting mechanism is made up of two main parts. Name these two parts.
5. Name the main two ways hay is conveyed to the center of the header.

Information Sheet
on
WINDROWERS

The windrower is relatively new, compared to other types of hay equipment. The purpose of the windrower is to place quality hay in a windrow. It does this by combining three operations--mowing, conditioning, and raking.

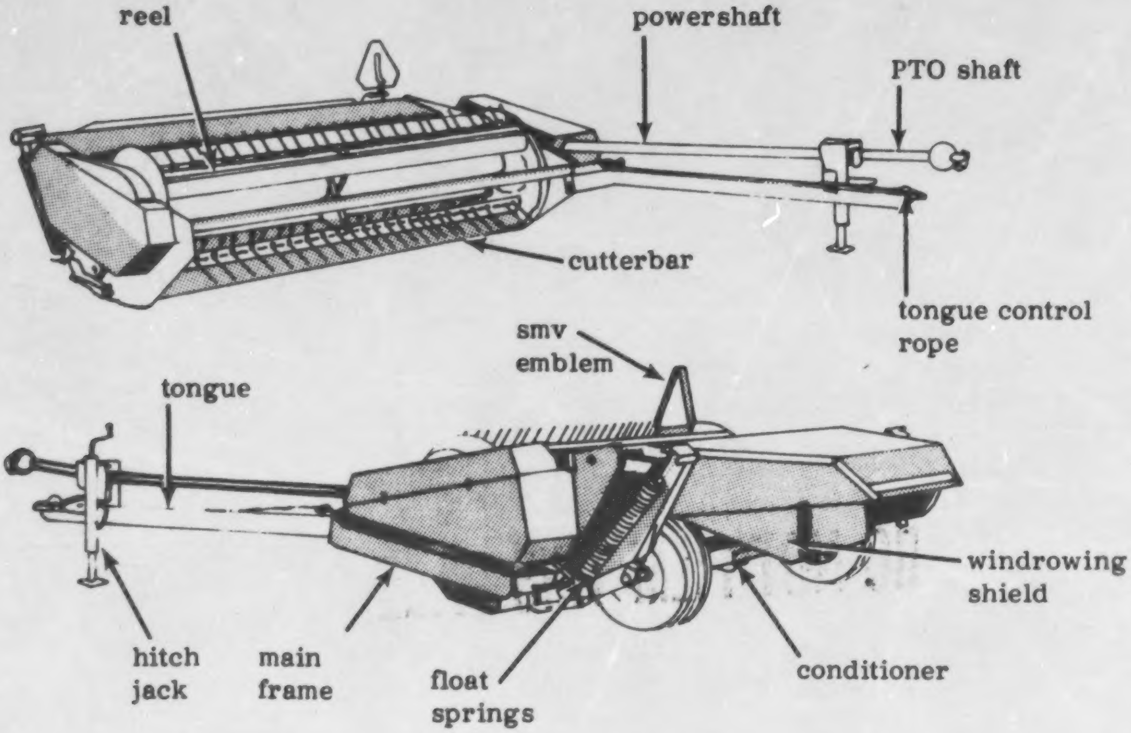
The windrower can be of two types: trailing or self-propelled. The trailing type is powered by the PTO from the tractor. It is usually smaller in size and, depending on the conditions, can cut, condition, and windrow about 30 to 50 acres per day. The trailing type of machine is usually used by land owners rather than by custom operators. The second type of windrower is self-propelled. It contains its own power source. This machine is larger and can cut, condition, and windrow about 80 acres per day, depending on the conditions. Most custom operators use this type machine.

As previously mentioned, the windrower combines three operations into one--cutting, conditioning, and windrowing the hay. This eliminates the operations of mowing, conditioning, and raking. However, the rake will still be needed in some cases to turn the windrow so the hay will dry. Operators have said that the windrower will eliminate one driver and one tractor.

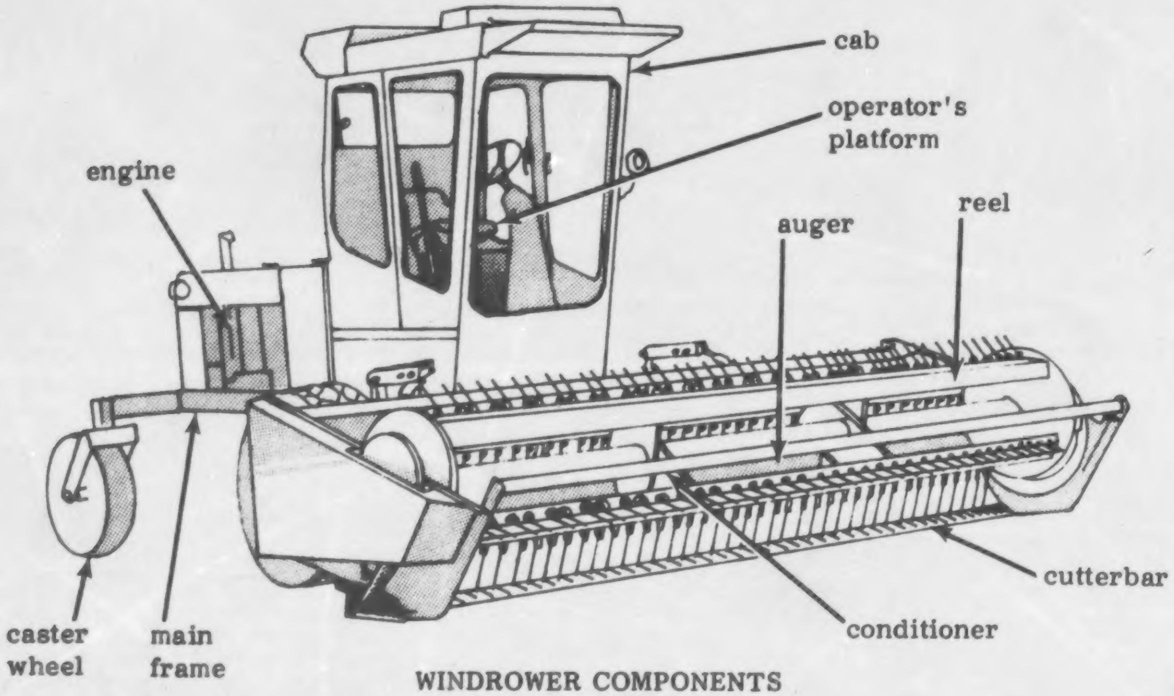
The windrower consists of three mechanical operations: cutting, feeding, and conditioning.

The cutting mechanism cuts the hay. Similar to the cutting mechanism of a combine, the windrower cutting mechanism consists of a cutter bar and reel. The hay is conveyed from the cutting mechanism to the center of the header by a canvas or auger, conditioned by the crimper or rollers, and placed in a windrow behind the machine.

For additional information, review Topics (1) "Mowers," (2) "Rakes." and (3) "Conditioners." These topics will provide the background needed for study on the windrower.


reel
powershaft
PTO shaft
cutterbar
tongue control rope
smv emblem
tongue
windrowing shield
hitch jack
main frame
float springs
conditioner

MOWER CONDITIONER COMPONENTS


cab
operator's platform
engine
auger
reel
cutterbar
caster wheel
main frame
conditioner

WINDROWER COMPONENTS

Assignment Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Hay and Forage Equipment

TOPIC: Balers

OBJECTIVE: To develop an understanding of the types, use, major parts, operation, and specifications such as capacity, bale dimension, size, etc. of balers.

REFERENCES:

1. Machines for Power Farming, pp. 430-449
2. Farm Machinery and Equipment, pp. 307-314
3. Information Sheet, "Balers"

QUESTIONS OR ACTIVITIES:

1. List the two main types of balers.
2. What are the two types of tying material used to tie bales?
3. Give the two types of power sources for balers.
4. How is the capacity of a baler expressed?
5. Give the two different types of balers according to the shape of the bale.
6. List two reasons why the size of balers is important.
7. What are the four processes involved in making a bale with a baler?
8. Describe how the pickup unit operates.
9. List the four main methods of feeding hay into the compressing chamber.
10. Name the five parts of the compressing mechanism.
11. List the five steps necessary in the tying mechanism.
12. What are the three parts which make up the chassis of a baler?
13. List eight major problems encountered in operating a baler.
14. List one method of correcting each major problem in operating a baler.

Information Sheet
on
BALERS

Two types of balers used to bale hay are:

1. Automatic-pickup, self-tying balers making rectangular bales
2. Automatic-pickup balers making round bales

Hay balers may be powered by:

1. Tractor power take-off
2. Air-cooled engine

Most manufacturers rate their machines by bales per minute or tons per hour. The number of tons per hour may not be a satisfactory figure. If the hay is damp, the number of tons per hour will be greater because each bale weighs more.

Baler size is also important, because during the off season it must be stored. Another important factor is the overall width when traveling on the highway.

Baler components are attached to the chassis. These consist of:

1. Frame
2. Wheels
3. Tongue

Four processes involved in making a bale with a baler are:

1. Pickup
2. Feeding
3. Compressing
4. Tying

The usual type of pickup mechanism on the baler consists of a drum or cylinder with spring steel teeth. The cylinder rotates in the opposite direction of the motor of the baler, lifting the hay and moving it into the machine.

At least four main methods of feeding the hay into the compressing chamber are commonly used on balers:

1. Auger and packer fingers
2. Spring teeth and feeder arms
3. Auger and feeder head
4. Carrier-roller feed

The feeding mechanism on the baler feeds the hay into the compressing chamber where the hay is pressed into a bale. The compressing mechanism is composed of five parts:

1. Plunger
2. Bale chamber
3. Tension bars or rails
4. Retaining plates
5. Metering wheel

Balers
(Information Sheet continued)

On the rectangular baler, the plunger is a rectangular framework that pushes against the hay as it is fed into the compressing chamber. The plunger has a set of knives along the side of the plunger that is situated next to the feeding mechanism. These knives shear off the hay as it is fed into the compressing chamber making a neat, smooth bale.

The bale chamber is the long rectangular box into which the plunger forces the hay. The tension bars or rails are located in the chamber and offer resistance to the plunger action, making a tight bale.

The retaining plates are located in the compressing chamber just out of reach of the plunger. They prevent the bale from moving back toward the plunger after each compression stroke.

The metering wheel is located on the compressing chamber and the spokes that make contact with the hay. As the hay moves through the compressing chamber, it turns the metering wheel. After making a complete turn, the metering wheel engages the tying mechanism.

The last function performed by a baler before it releases the bale is that of tying it. Bales may be tied with either twine or wire.

There are five steps in tying a bale:

1. Needle brings lower wire around end of bale.
2. Needle places wire below other wire in twister pinion.
3. Twister pinion revolves four times, twisting both wires securely.
4. Kinker shaft and cutoff turn to outside, kinker shaft kinks knot on bale; cutoff shaft cuts, twists, and kinks knot for next bale.
5. Shafts return to neutral position; needles move downward, drawing wire into position for next bale.

On the round baler, the hay is fed into a series of rolling belts. The lower set of belts rotate in the opposite direction from that of the upper series of belts. The hay is turned in a circular motion, forming a round bale. After the bale becomes so large, it trips the trip rollers which release the bale.

Some of the major problems encountered in operating a baler are:

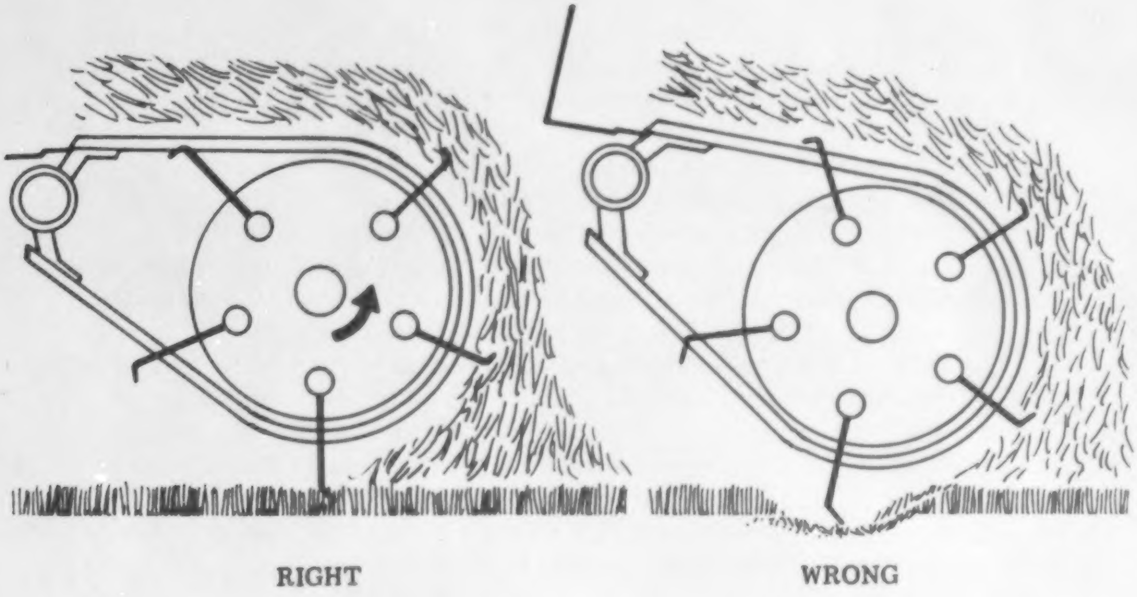
Feeding too fast; irregular feeding
Making bales too heavy
Loose shear bolt nuts
Needles not timed properly

Balers
(Information Sheet continued)

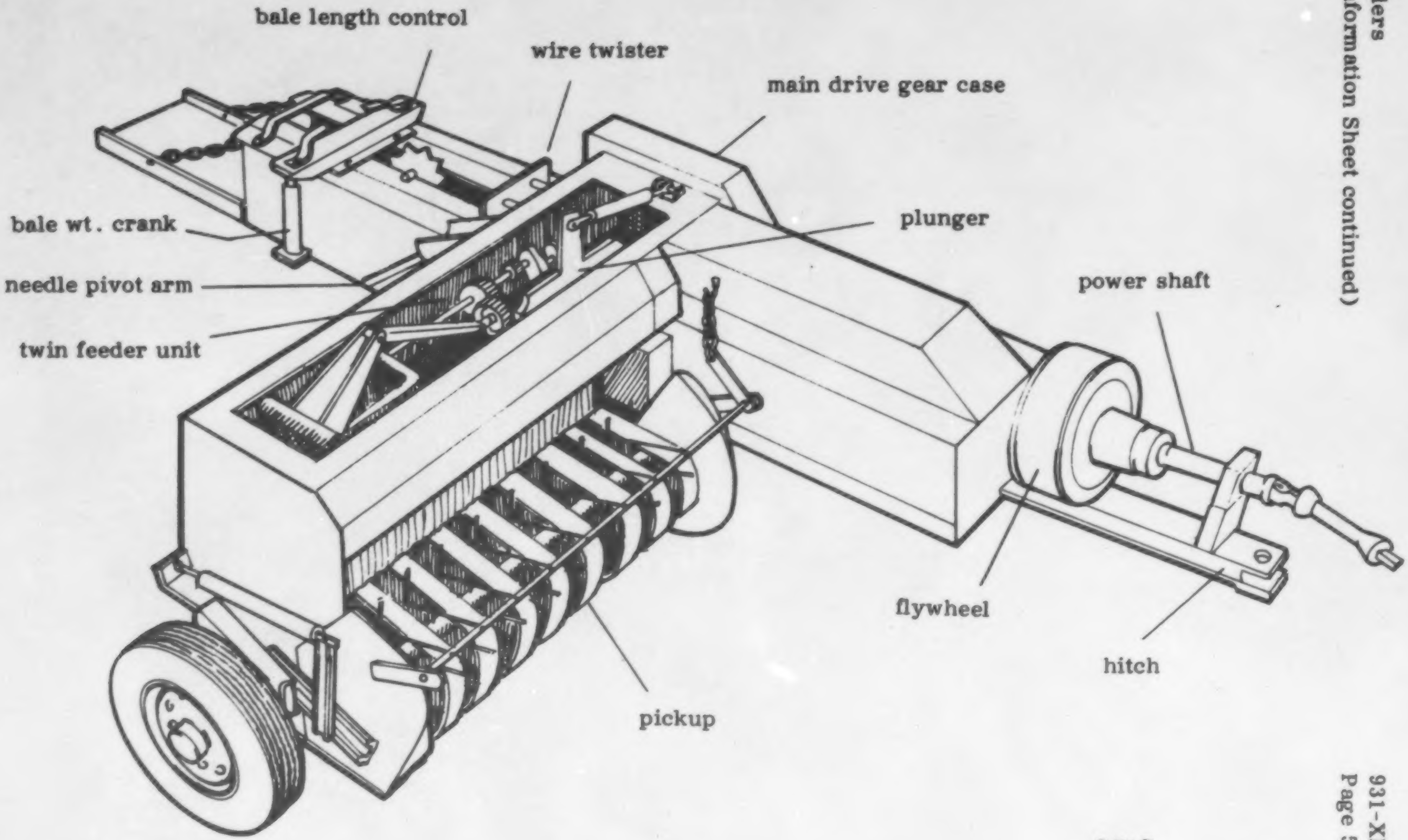
Needle safety latch not adjusted properly
Extremely dull knives
Excessive clearance between knives
Improperly adjusted or worn needle brake

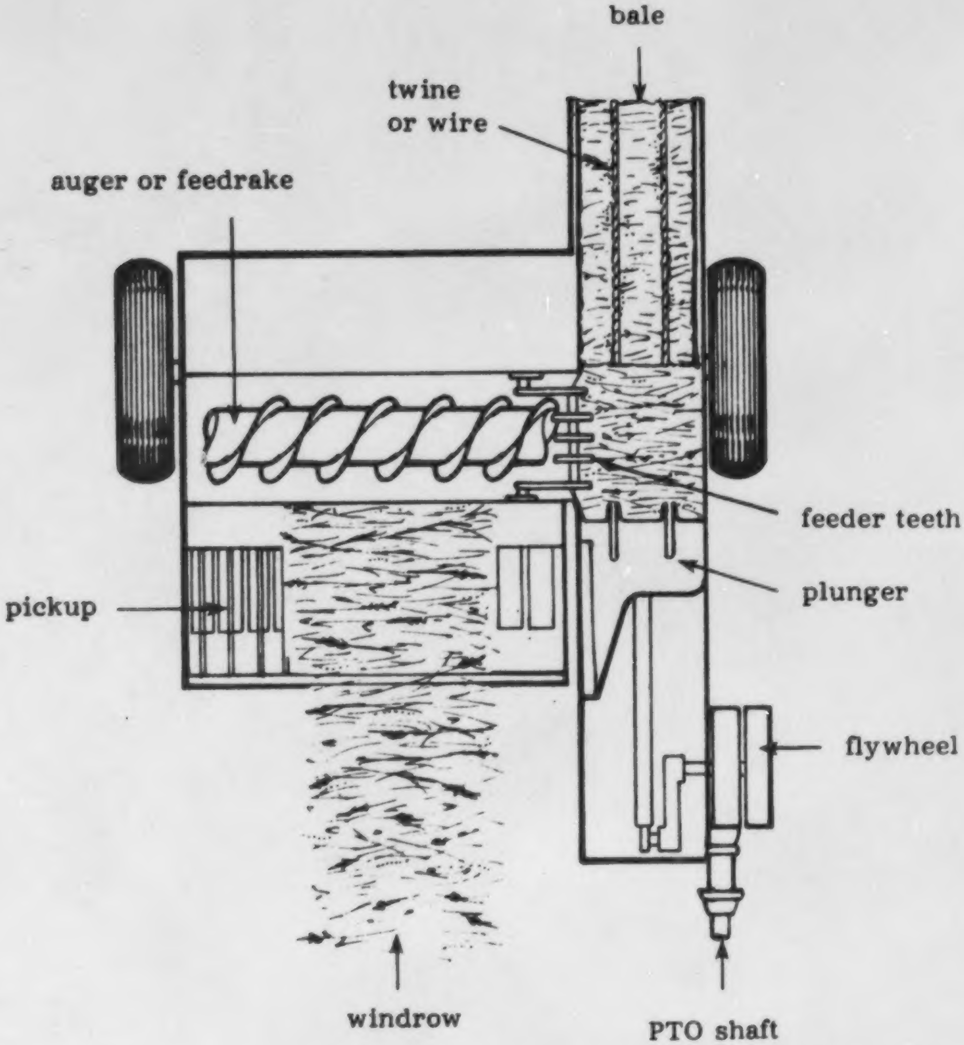
These problems can usually be corrected by observing certain operating practices and making baler adjustments. Practices and adjustments are:

Slow down so feeding rate is not less than 12 strokes per 36" bale; feed uniformly
Loosen bale tension
Tighten nuts securely; always use a lock nut
Time tying mechanism
Adjust safety latch
Sharpen or replace knives
Adjust plunger - knife clearance
Apply more tension or replace linings

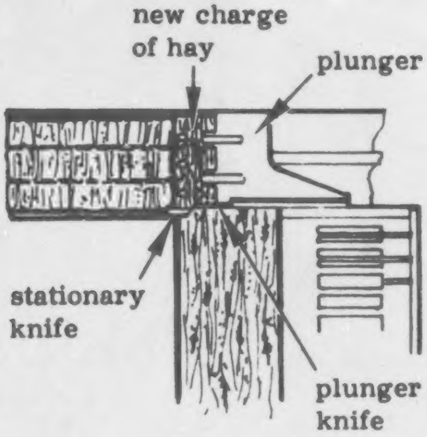

RIGHT WRONG

PICKUP HEIGHT

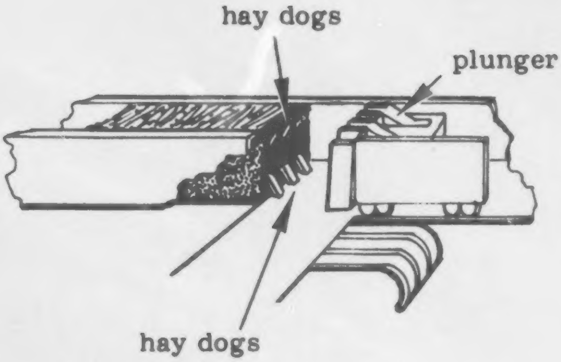

bale length control
wire twister
main drive gear case
bale wt. crank
plunger
needle pivot arm
power shaft
twin feeder unit
flywheel
hitch
pickup


bale
twine or wire
auger or feedrake
feeder teeth
plunger
pickup
flywheel
windrow
PTO shaft

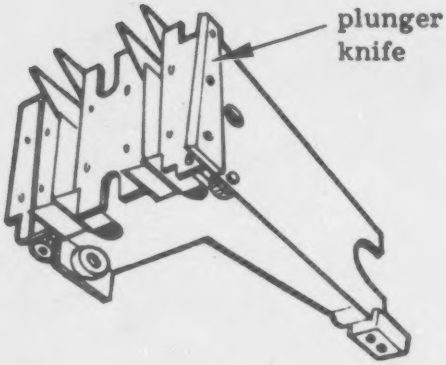
HAY MOVEMENT INTO THE BALING CHAMBER


new charge of hay
plunger
stationary knife
plunger knife

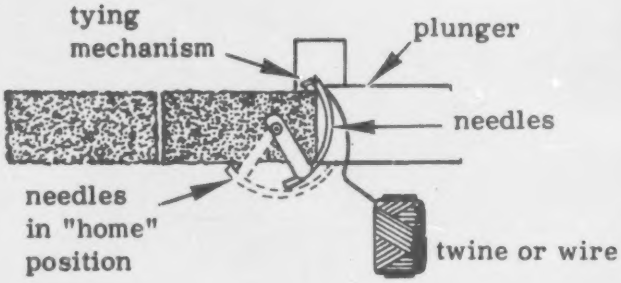
HAY COMPRESSION


hay dogs
plunger
hay dogs

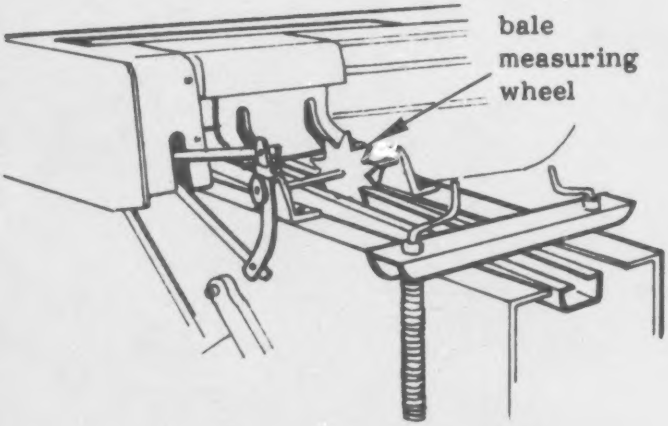
HAY DOGS


plunger knife

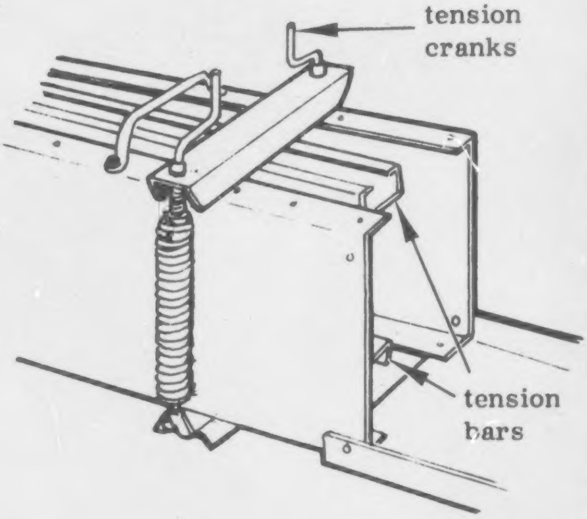
PLUNGER AND KNIFE


tying mechanism
plunger
needles
needles in "home" position
twine or wire

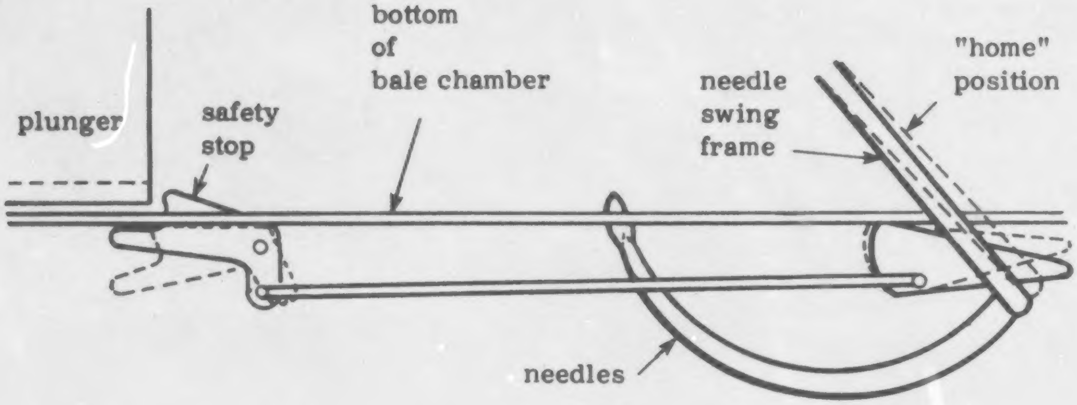
TYING OPERATION


bale measuring wheel

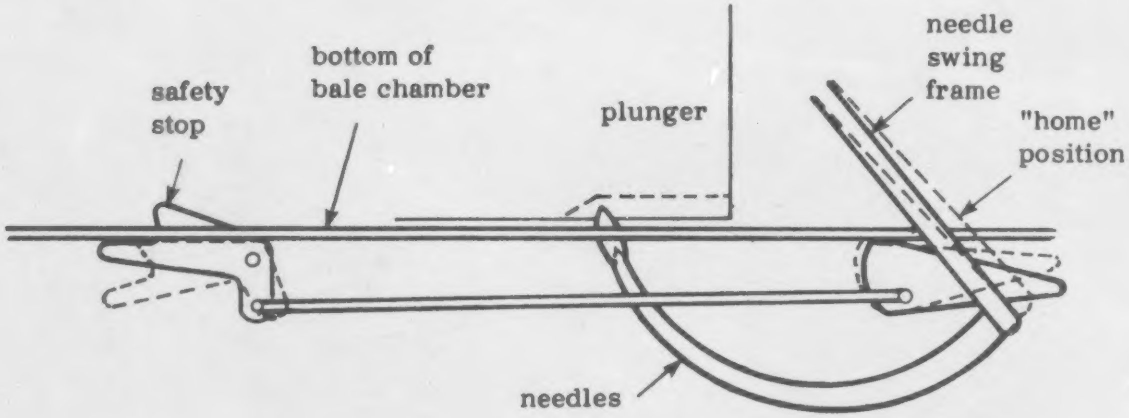
BALE LENGTH CONTROL'


tension cranks
tension bars

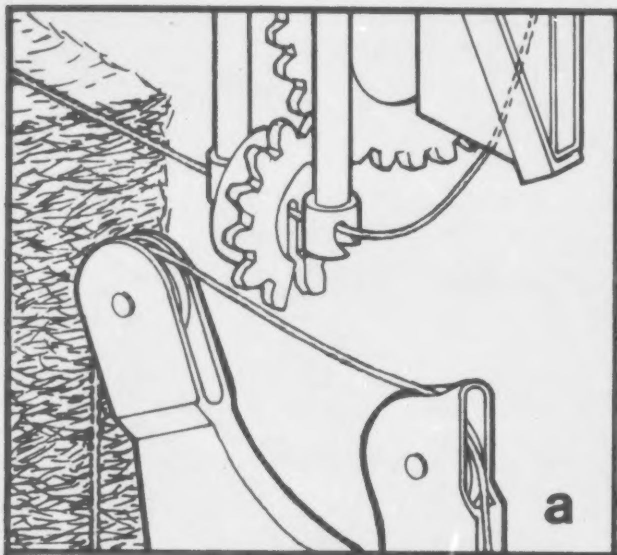
BALE DENSITY

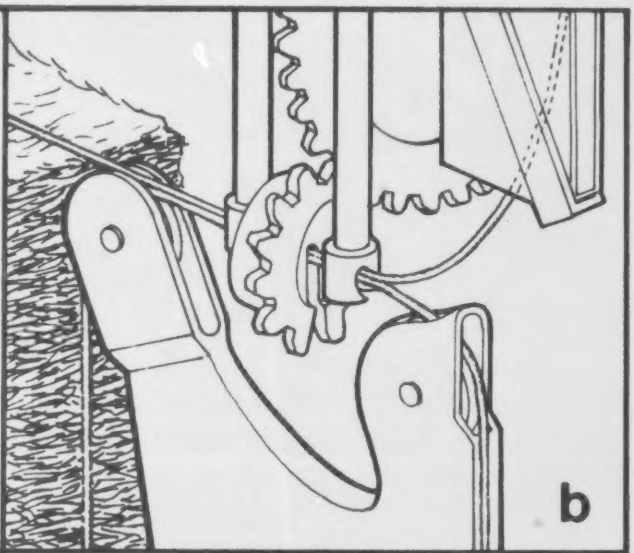

plunger
safety stop
bottom of bale chamber
needle swing frame
"home" position
needles

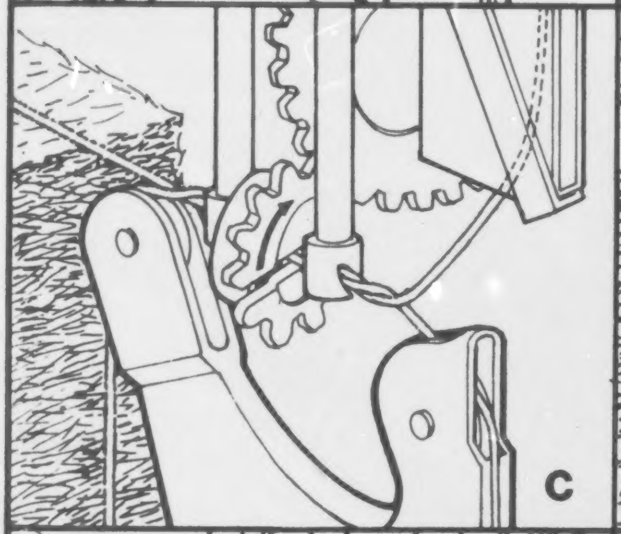
"A" - NEEDLE PROTECTION FROM PLUNGER

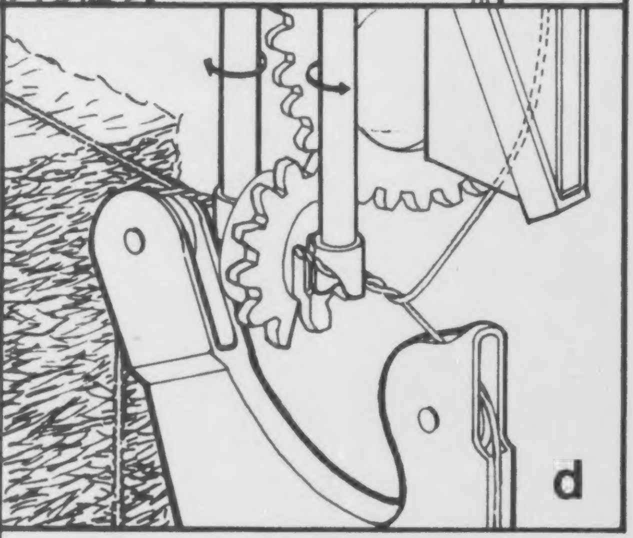

safety stop
bottom of bale chamber
plunger
needle swing frame
"home" position
needles

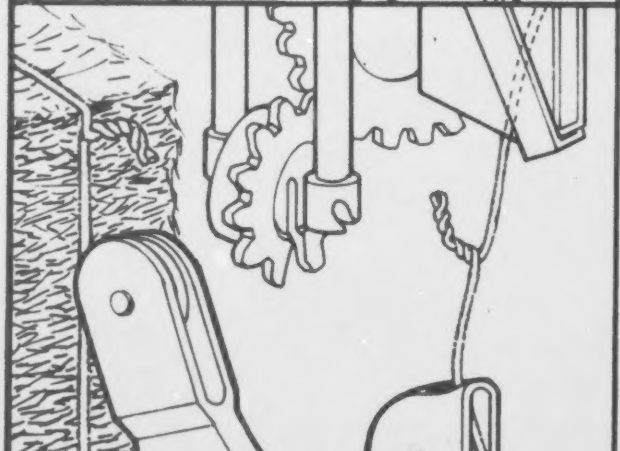
"B" - NORMAL PLUNGER OPERATION



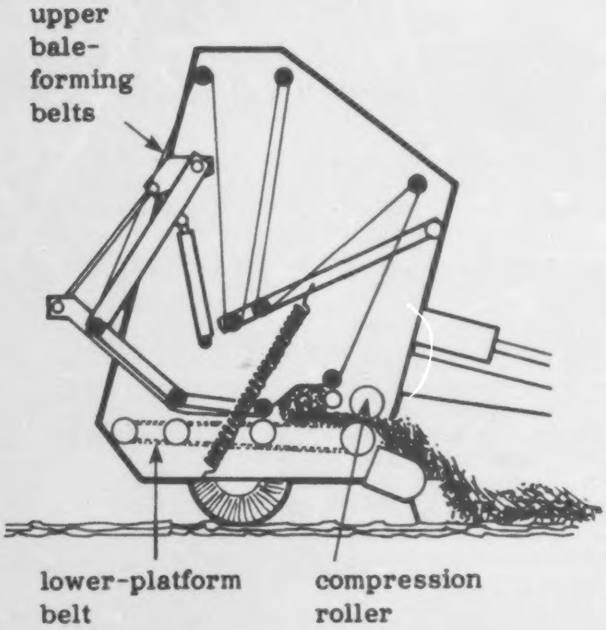




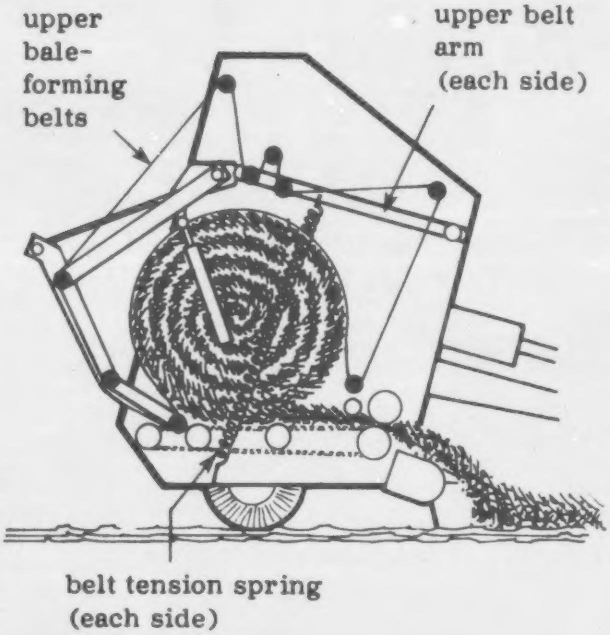




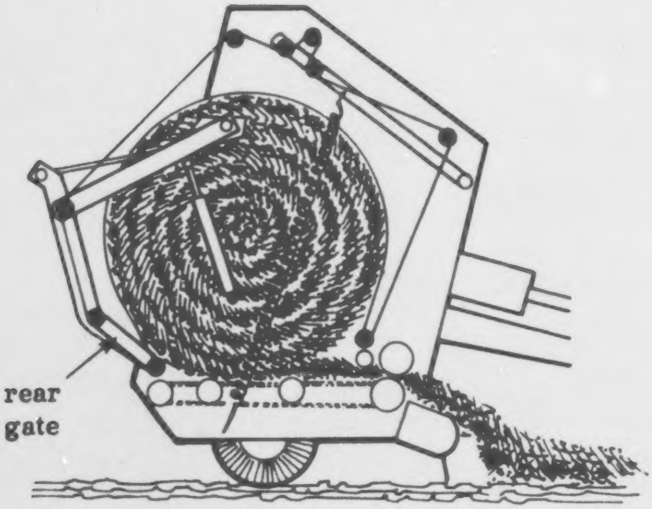
a. Lower wire is brought around end of bale by needle.
b. Wire placed under other end by twister pinion.
c. Wires are twisted together by twister pinion as it revolves four times.
d. Knot is kinked on bale by kinker shaft. The twist is cut by cutoff shaft and the knot is kinked for next bale.
e. The needles move downward as the shafts return to neutral position.


upper bale-forming belts
lower-platform belt
compression roller

STARTING A BALE


upper bale-forming belts
upper belt arm (each side)
belt tension spring (each side)

FORMING A BALE



COMPLETING A BALE

Assignment Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Hay and Forage Equipment

TOPIC: Forage Harvesters

OBJECTIVE: To develop an understanding of the different types, uses, major mechanisms, parts, and operation of forage harvesters. Also, to understand the purpose and some specifications.

REFERENCES:

1. Machines for Power Farming, pp. 450-469
2. Farm Machinery and Equipment, pp. 317-324
3. Information Sheet, "Forage Harvesters"

QUESTIONS OR ACTIVITIES:

1. Give the purpose of the forage harvester.
2. What are the two types of forage harvesters which have been developed?
3. List the three types of field choppers used by farmers.
4. What are the basic units which go to make up a field chopper?
5. What are the three processes involved in the operation of the forage harvester?
6. Name three attachments available for the forage harvester.
7. What are the two principal types of cutter heads used on forage harvesters?

Information Sheet
on
FORAGE HARVESTERS

The primary purpose of forage harvesting machinery is to chop field crops and place the chopped crop in a wagon. Two types of forage harvesters have been developed to accomplish this purpose--the field chopper and the flail chopper.

The field chopper is by far the most versatile of the two types. This versatility comes from its ability to be adapted to a variety of crop or forage production methods. For example, a unit has been developed for use in harvesting row crops, a unit for picking up forages in the windrows, etc.

There are three types of field choppers used by farmers:

1. Tractor-drawn
2. Tractor-mounted
3. Self-propelled

The basic unit of the field chopper is made up of the following parts:

1. Wheels
2. Axle
3. Frame
4. Cutter head
5. Blower
6. Feeding mechanism

This unit is powered through the PTO and the tractor. The power from the PTO shaft is carried to the basic unit through the PTO shaft in the harvester.

Three processes are involved in the operation of the forage harvester: cutting and feeding, chopping, and blowing.

The feeding and cutting mechanism will vary according to the type of unit attachment that is being used on the harvester. If a row crop unit is being used, an oscillating sickle is used to sever the plants. The plants are moved back toward the chopping unit. If a broadcast unit attachment is used, a mower-like cutter bar cuts the crop. A reel is used to throw the severed plant against an apron which carries the forage back to an auger. The auger in turn carries the material to the chopping unit. If a windrow pickup is used, revolving fingers lift the forage from the windrow and move the hay to the auger. The auger in turn moves the forage to the chopping mechanism.

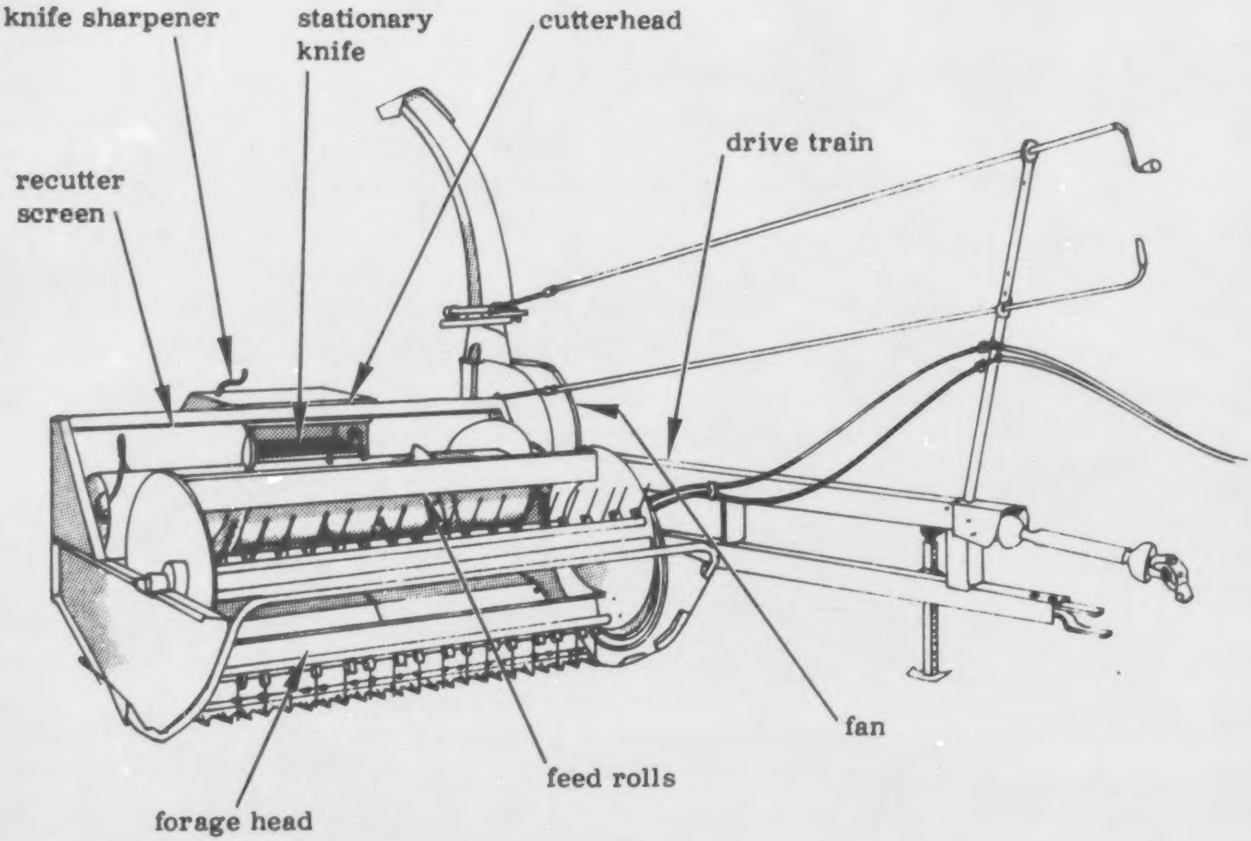
Two principal types of cutterheads are used on forage harvesters--flywheel and cylinder.

The flywheel-type cutter head performs two functions: chopping and blowing. The blower paddles are separate from the cutter knives. As the wheel turns, the knives cut the forage and blower paddles blow the chopped forage up and out of the blower spout.

Forage Harvesters
(Information Sheet continued)

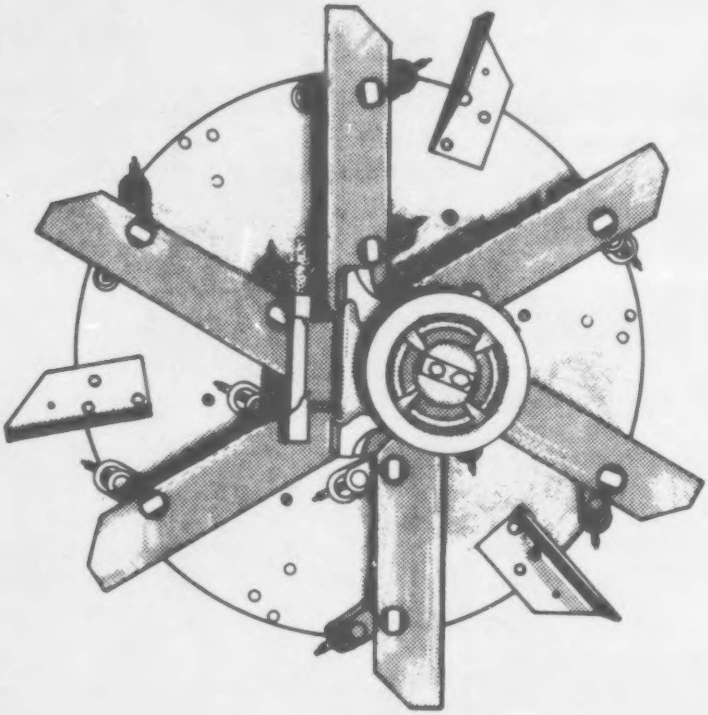
The cylinder-type cutter head has knives designed to both cut and blow; however, some require a blower to force the chopped forage out of the harvester.

The flail-type harvester uses free-swinging chains, hammers, or knives to sever the plants through a beating or cutting action. The chopped hay is drawn into the blower fan and blown through the blower spout into the wagon.

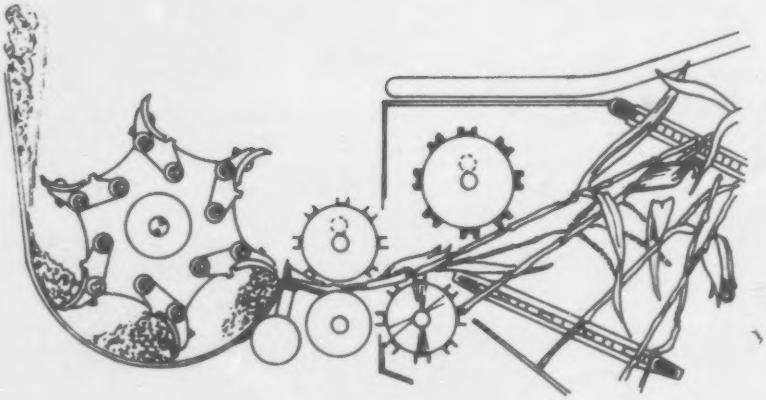

knife sharpener
stationary knife
cutterhead
drive train
recutter screen
fan
feed rolls
forage head

BASIC FORAGE HARVESTER COMPONENTS

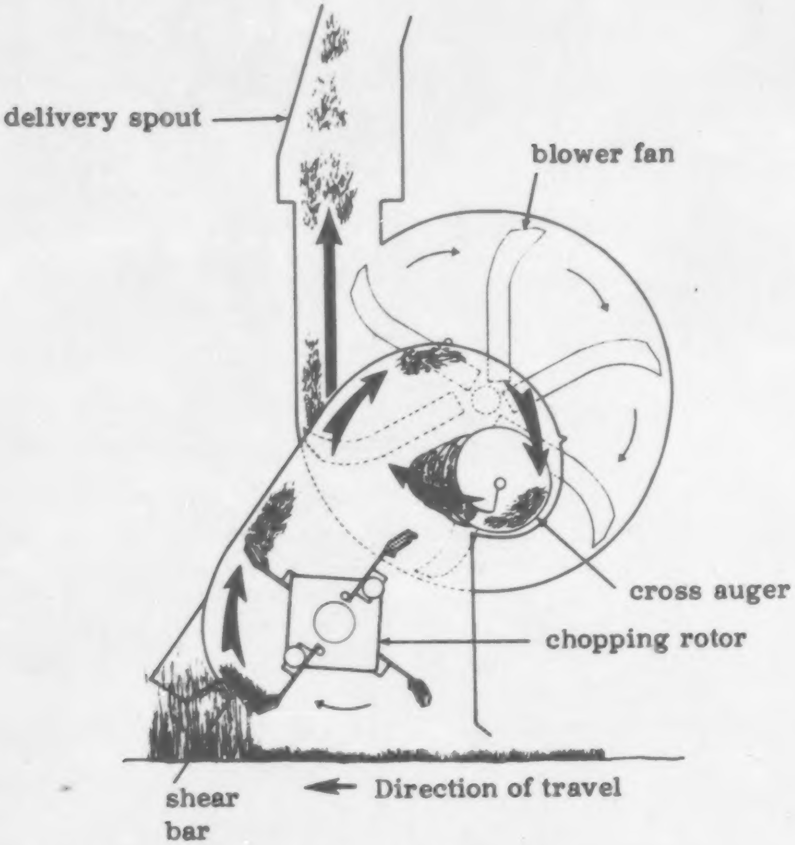
TWO TYPES OF CUTTERHEADS FOR FIELD FORAGE HARVESTERS



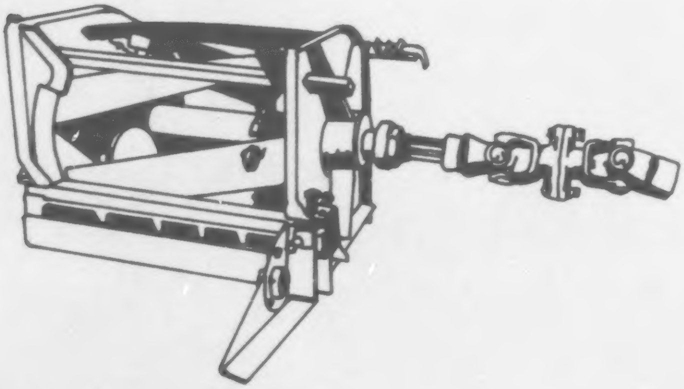
FLYWHEEL-TYPE



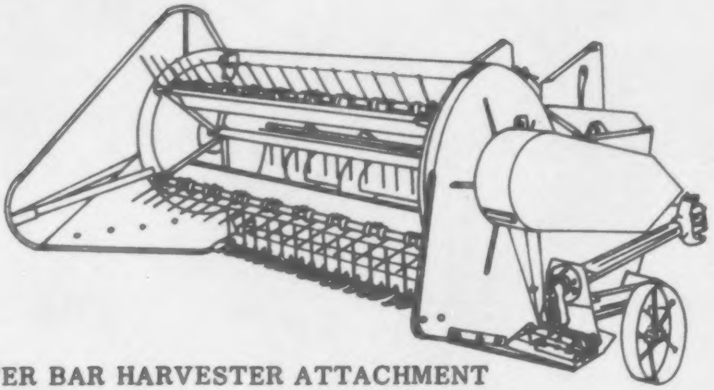
CYLINDER-TYPE


delivery spout
blower fan
cross auger
chopping rotor
shear bar
Direction of travel

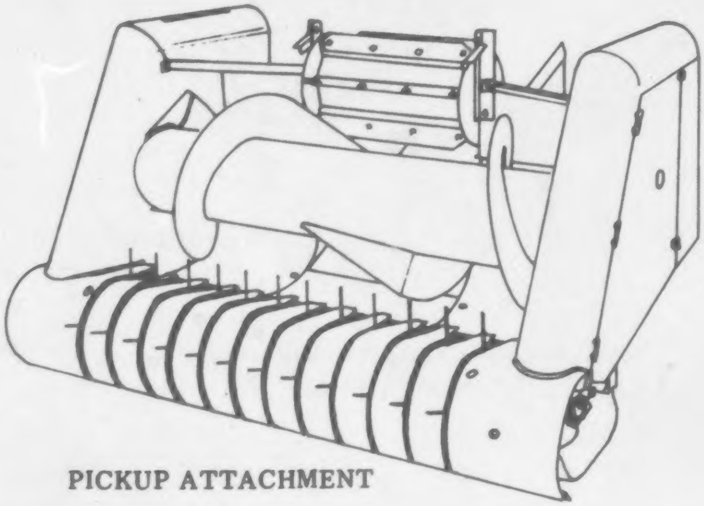
FLAIL KNIVES CUTTING FORAGE AGAINST SHEARBAR



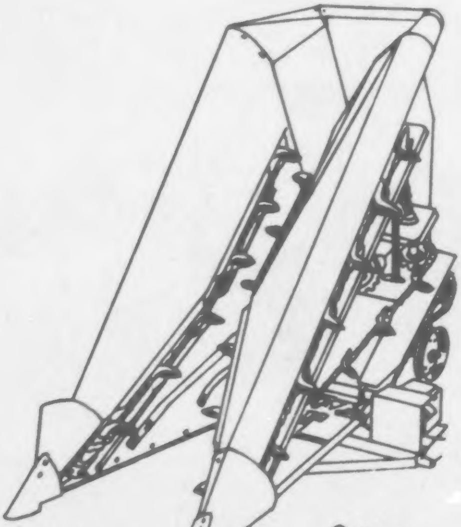
REEL TYPE OF CUTTING



WIDE CUTTER BAR HARVESTER ATTACHMENT



PICKUP ATTACHMENT



ROW-CROP ATTACHMENT

Assignment Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Special Equipment

TOPIC: Farm Elevators

OBJECTIVE: To develop an understanding of the types of farm elevators available and how they operate.

REFERENCES:

1. Operator's Manual for farm elevator from implement company
2. Farm Machinery and Equipment, pp. 443-446
3. Information Sheet, "Farm Elevators"

QUESTIONS OR ACTIVITIES:

1. In general, the elevators used on farms today may be classified into two major groups. Name these major groups.
2. List the three types of portable elevators.
3. Describe the parts and give the specifications of the chain drag-flight elevator.
4. Name the two types of hoppers available for use on the drag-flight elevator.
5. What are the three sources of power for auger and chain drag-flight elevators?

Information Sheet
on
FARM ELEVATORS

Farm elevators are a labor saving device. In general, these elevators may be classified as either portable or stationary. Portable elevators are one of three types:

1. Chain drag-flight
2. Auger
3. Blower

The chain drag-flight elevator is available in lengths ranging from 16' to 50'. The trough may be narrow and V-shaped and use a single chain, or it may be as wide as 20" with a chain on each side of the chute to support each end of the drag flights. These may be used for loose grain, ear corn, hay, and sacks of feed.

The auger portable elevator consists of an enclosed section of a screw conveyor. It is suitable for grain elevating and conveying.

The blower type elevator is most useful where large quantities of grain are handled. These machines will elevate from 300 to 1200 bushels of grain per hour to heights of 25 to 30 feet.

Stationary elevators are most often used on grain storage facilities. These are almost always vertical and are of the bucket type, although any of the portable elevators may be used as permanant stationary elevators.

Two types of hoppers are available for the drag-flight type. The trapezoidal-shaped hopper requires hand labor to load the elevator. The long rectangular-folding type hopper is suitable for handling materials dumped from a trunk.

Elevators may be powered by:

1. Small electric motors
2. Gasoline engines
3. Tractor power take-off

Assignment Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Special Equipment

TOPIC: Feed Mills

OBJECTIVE: To develop an understanding of the major parts and steps involved in the operation of a feed mill.

REFERENCES:

1. Operator's Manual for feed mill from implement company
2. Information Sheet, "Feed Mills"

QUESTIONS OR ACTIVITIES:

1. What types of feed can be ground in a feed mill?
2. What two types of power are used most frequently to power the feed mill?
3. List the major parts of a feed mill.
4. List the first two steps in preparing the feed mill for operation.
5. List four basic facts to keep in mind when adjusting the hammer mill.

Information Sheet
on
FEED MILLS

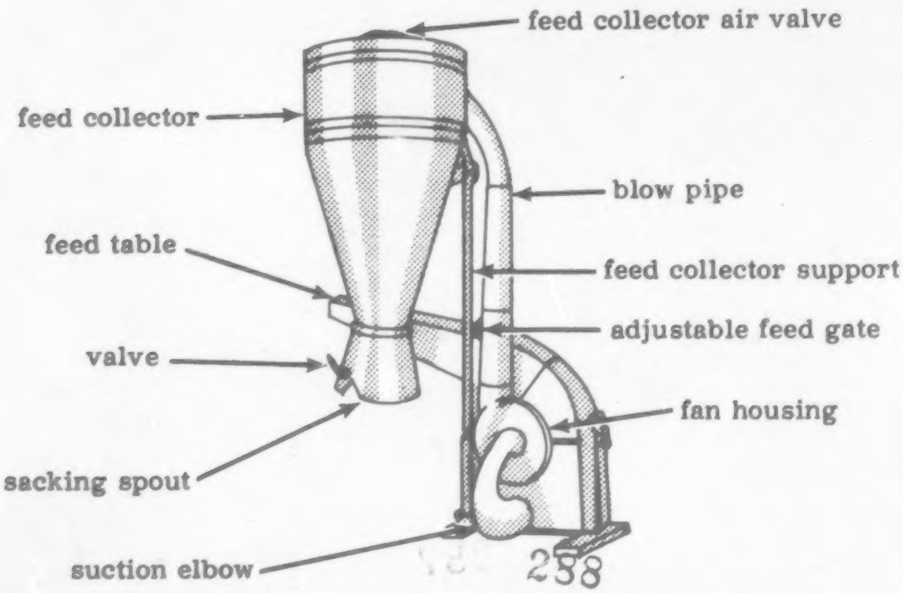
The hammer mill has solved the feed-grinding problem on many farms, enabling the individual farmer to grind feed as the need arises and convenience permits, rather than to depend upon the custom grinder for this important work.

The modern hammer mill is designed to grind practically every type of feed, including small grain, shelled or ear corn, fodder, and hay, to the size best adapted to the feeding purpose for which it is intended. With the wide variety of screens available for present-day mills, feeds may be ground to any practical degree of fineness, ranging from extremely fine meal or flour to coarse roughage.

Many of the present mills may be operated successfully by electric motors of 3 to 10 h.p., using the motor-mounting attachment supplied by the manufacturer. Where electric power is available, the electric motor drive is used to power the mill while the farm tractor is free for other jobs.

The material to be ground is fed into the chamber of the mill where the hammers, revolving at high speed, cut it in mid-air, throw it against the breaker bars to be picked up and recut until it is reduced to particles small enough to pass through the screen which determines the fineness of the grinding. As the ground material passes through the screen, a suction fan draws it from the mill and forces it through the blow-pipe into the feed collector for final delivery to sacks, bins, or wagons.

EXTERNAL COMPONENTS OF A HAMMER MILL



Feed Mills
(Information Sheet continued)

The first step in preparing the hammer mill for operation is to select the proper screen, place it in the screen groove, and lock it in position, making certain that the screen and screen lock are seated properly. The air suction control should be set so that the proper amount of air is drawn through the screen for efficient grinding. When grinding on an extremely fine screen, more air should be drawn through the screen so that light hulls which, with a lighter suction, would rotate with the rotor, will be reduced quickly and drawn through the screen. When extremely coarse screens are used, the suction slide may be closed entirely. A two-piece feed control on the feed table governs the flow of material from the feed table to the mill. The smaller gate is used when feeding small grains (including shelled corn), while, for ear corn, both gates are raised just high enough to permit the ears to pass. Except when grinding hay or fodder, feed control should always be in place to regulate the air intake at the feed opening.

In adjustment, the hammer mill is free of complicated problems. However, there are several basic facts which the operator must keep in mind constantly. In the first place, the rotor shaft of the hammer mill turns at high speeds; therefore, special attention should be given to proper greasing and proper adjustment of all bearings. The rotor shaft, with the hammer mounting plates, hammers, and spacing collars, must be kept in proper balance to insure freedom from vibration which would damage the bearings and shorten the life of the entire mill. To preserve this balance, all hammers must be sharpened, reversed, or replaced at the same time; in reassembling, particular care must be used to make certain that all cast-iron spacing collars are replaced in their original order. If vibration appears, the mill should be stopped immediately and checked carefully for broken hammers. When replacing a broken hammer, the corresponding hammers in the other banks should be replaced to insure proper balance; any small difference in weight will result in vibration.

When hammers are dulled from wear, they may be reversed to present new cutting steps. When both edges are dulled, hammers may be removed and sharpened on a good emery wheel. This is an important servicing operation; the hammers must retain their original cutting steps for effective work. To insure best service from the hammer mill, hammers should be ground before they become too badly worn.

The blower and feed collector require little attention other than an occasional inspection to be sure all joints are tight. An air control damper is provided so that the blast of air can be controlled to eliminate loss of light or exceptionally fine material. Thus, the operator may adjust the air pressure to insure proper movement of the ground material without forcing finely-ground meal through the sack.

Feed Mills
(Information Sheet continued)

Highly important in the successful operation of any hammer mill is the maintenance of rated speed as specified by the manufacturer of the mill. Careful attention to lubrication and to proper adjustment of all moving parts will result in efficient operation and long life of the mill.

Assignment Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Special Equipment

TOPIC: Feed Grinder - Mixers

OBJECTIVE: To develop an understanding of the specifications, operation, lubrication, trouble-shooting, and service of a specific feed grinder-mixer.

REFERENCES:

1. Operator's Manual for a feed grinder-mixer from implement company
2. Information Sheet, "Feed Grinder - Mixers"

QUESTIONS AND ACTIVITIES:

1. Describe in general a grinder - mixer unit.
2. List five advantages of operating a mobile grinder mixer.
3. What are the main parts of a grinder mixer?
4. List three methods farmers use to grind and mix feed.
5. List the three stages of grinding small grains.
6. What part of the hammermill is used to reduce the size of material from a whole grain or forage to finer or smaller material?

Information Sheet
on
FEED GRINDER - MIXERS

A feed grinder - mixer is considered a single unit machine that grinds and mixes feed. The grinder and mixing units are fixed on the same chassis. Feed is ground in the feed grinder and conveyed by auger or blown into the mixing tank where it is mixed with other feeds. The feed grinder-mixer is actually a small feed mill. It processes and mixes feed in the same manner as a large feed mill.

There are two types of grinder - mixer units: stationary and mobile. Mobile units are usually mounted on rubber tired wheels for ease of moving to different locations on the farm.

The advantages of operating a mobile unit are as follows:

1. The handling of feed may be reduced to a minimum.
2. Mixed feed can be moved and distributed to feeding areas directly from the grinder - mixer.
3. The cost of sacking or putting feed into containers can be eliminated. Fresh feed can be stored in mixing tank.
4. Time is reduced in processing rations such as mixing concentrates with roughages.
5. Outside traffic entering a farm may transport diseases; this condition may be prevented by using a farm owned feed unit with home grown feeds.

The main parts of a grinder - mixer are: the chassis or frame, hammer mill, mixing tank, drive, conveyor, and loading and unloading mechanisms.

Many farmers continue to use the following feed processing methods:

1. Use a shovel to mix feed that has been ground with the hammer mill.
2. Have feed mixed by a mobile feed mixer.
3. Hand mix whole grain with roughages and concentrates.
4. Haul feed to a commercial feed mill and have it ground and mixed.

Most grains and forages can be better utilized by livestock if the feed is ground. In order to be sure that an animal receives the proper amount of roughage, concentrates, and minerals, it is usually advisable to mix the feed ingredients together to balance a ration.

Grain is ground in three different sizes: fine, medium, and coarse. Cattle consume most grains that are ground medium to coarse; swine need medium

Feed Grinder - Mixers
(Information Sheet continued)

ground grains; and sheep eat coarse ground grain with the exception that grain sorghum should be medium ground.

The fineness or coarseness of grinding is determined by the size of mesh in a hammer mill screen.

Mixer tank sizes are determined by the amount of feed the tank will hold. Hammer mills are designed to operate at a certain number of rpms which is the hammer mill rotor speed.

The general sequence for grinding and mixing feed may be:

1. Align the tractor with the mill hitch and attach hitch and PTO to the tractor.
2. Engage the hammer mill clutch.
3. Shift the discharge auger clutch out of gear.
4. Install the desired size screen.
5. Place the feed auger in the proper position.
6. Start the tractor and adjust the feed auger cover to the proper position.
7. Engage the feed auger drive clutch and feed materials into the hammer mill.
8. Observe feed mixing by viewing the feed through the mixing tank windows.
9. Weigh and add the proper amount of concentrates through the concentrate hopper or container.
10. Stop the hammer mill when the mixing tank is full or mixing is completed.
11. Unload the tank by engaging the discharge auger clutch.

Assignment Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Special Equipment

TOPIC: Post-Hole Diggers

OBJECTIVE: To develop an understanding of the specifications, operation, lubrication, trouble-shooting, and service of a specific post-hole digger.

REFERENCES:
1. Operator's Manual for post-hole digger from implement company
2. Information Sheet, "Post-Hole Diggers"

QUESTIONS OR ACTIVITIES:

1. Study carefully the General Specifications section of the operator's manual for the post-hole digger.
2. Study the specific lubrication requirements of the post-hole digger, with special emphasis on daily lubrication.
3. Study the Operation section of the operator's manual and be able to describe the operation of the post-hole digger.
4. Study the Trouble-Shooting section or Service section of the operator's manual to understand how to service the post-hole digger.
5. What is the penetrating depth of a post-hole digger and what is the width or diameter of holes it will bore?
6. Where is the digger mounted on the tractor?
7. Explain how the digger operates.

Information Sheet
on
POST-HOLE DIGGERS

A power-driven post-hole digger is considered a very important piece of labor saving equipment on the average farm and ranch. It is used mainly to dig post holes for fences, but it is also used to dig holes for pole buildings and building foundations for concrete piers or posts. Most standard diggers bore a hole about three and one-half feet deep and from four to twelve inches in diameter. Diggers may be made to bore holes at a greater depth than three and one-half feet by using an extension on the auger.

The most common type of post-hole digger is tractor-mounted and power-take-off driven. The power-take-off drive shaft is connected to the digger gear box. There is a universal joint at each end of the telescopic shaft. The adjustable shaft plus the universal joints permit the digger to be operated up and down without a binding pressure on the attachments. The auger should be attached to the driving shaft at the gear box by a shear pin. This pin is cut if the auger contacts an object stopping its movement.

Most diggers are mounted on the rear of the tractor and are raised and lowered by power pressure from a hydraulic pressure unit. This pressure also forces the auger into the ground and pulls it out even if there is a tendency for it to continue to penetrate the soil.

The cutting edges of the auger bit most be kept sharp at all times if the digger is to function properly. When operating a power digger in rocks or stumps, the cutting edges of the auger bit will be dulled more quickly and more shear bolts will be broken. When a shear bolt is broken it should be replaced with a bolt of the same softness to insure against future damage to the equipment.

When operating in roots, the digger may have a tendency to bury itself. If this occurs, it must be backed out by hand. A pipe wrench should usually do the trick.

Assignment Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Special Equipment

TOPIC: Crop Drying Equipment

OBJECTIVE: To develop an understanding of the specifications, operation, lubrication, trouble-shooting, and service of crop drying equipment.

REFERENCES:

1. Operator's Manual for crop dryer from implement company
2. Farm Machinery and Equipment, pp. 425-441
3. Information Sheet, "Crop Drying Equipment"

QUESTIONS OR ACTIVITIES:

1. Study the General Specifications section of the operator's manual, giving special emphasis to:
    (a) Capacity
    (b) Drying rate
    (c) Power requirement
    (d) Fan
2. Study the specific lubrication requirements of the crop dryer with emphasis on daily lubrication.
3. Study the Operation section of the operator's manual and be able to describe the operation of the crop dryer.
4. Study the Trouble-Shooting section or Service section of the operator's manual to understand how to service the crop dryer.
5. What was the purpose of using heated air on tobacco in 1830?
6. What were the first crops dried by forced heated air in the 1930's?
7. How are the two most common crop dryers used?
8. What is the heat exchanger and how does it function?
9. List the moisture content for storing shelled corn, wheat, sorghum, rice, oats, and peanuts.

Information Sheet
on
CROP DRYING EQUIPMENT

Drying crops has been a common practice since ancient times. The sun was the first drying agent. In 1830 Virginia tobacco farmers used hot air to color tobacco leaves. Sweet potatoes and hay were among the early crops to be dried with heated air. Many agricultural crops contain too much moisture when harvested to be stored safely; therefore, they must be dried.

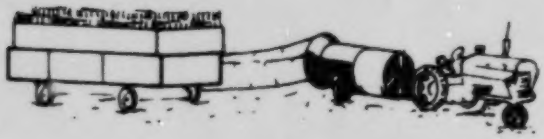
The two most common types of dryers are the continuous flow and the batch dryer. Continuous flow dryers are usually considered horizontal or tower dryers that are installed in a permanent location. Batch dryers can be moved to a location where they are needed.

Dryers for both hay and grain may be constructed on the farm. Any number of systems may be used.

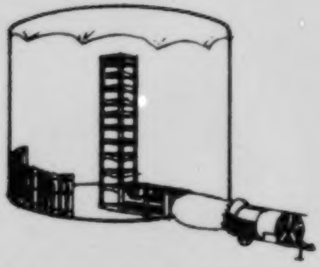
A crop dryer consists of a heating unit and ducts, chambers or passages to direct the air, and the container for the crop. Heat exchangers are often used for heating. They are made up of two main units, heating and air movement. Cold air is drawn past the burner and flame, and the hot air and gases are blown through the crop.

The moisture contents for safe storage of selected crops are:

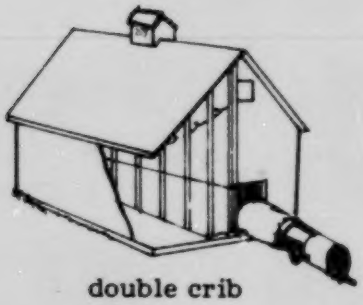
Shell corn	13%
Wheat	13%
Sorghum	12%
Rice	13%
Oats	13%
Peanuts	7-9%



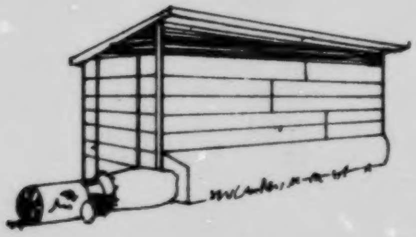
trailer wagon



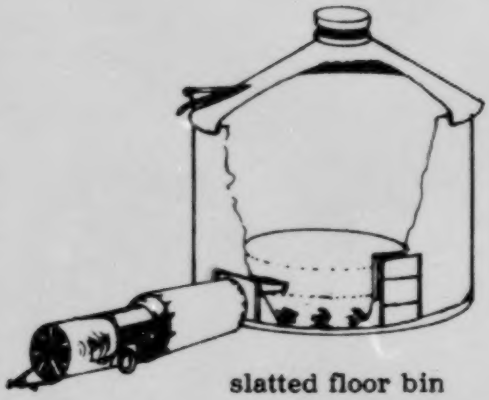
slat fence bin
with central duct



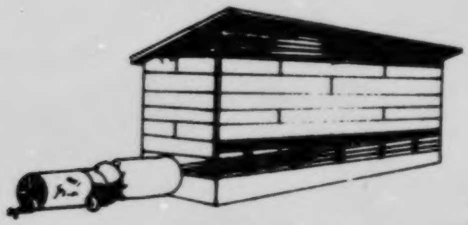
double crib



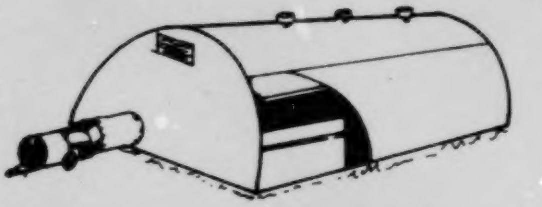
bin with side duct



slatted floor bin

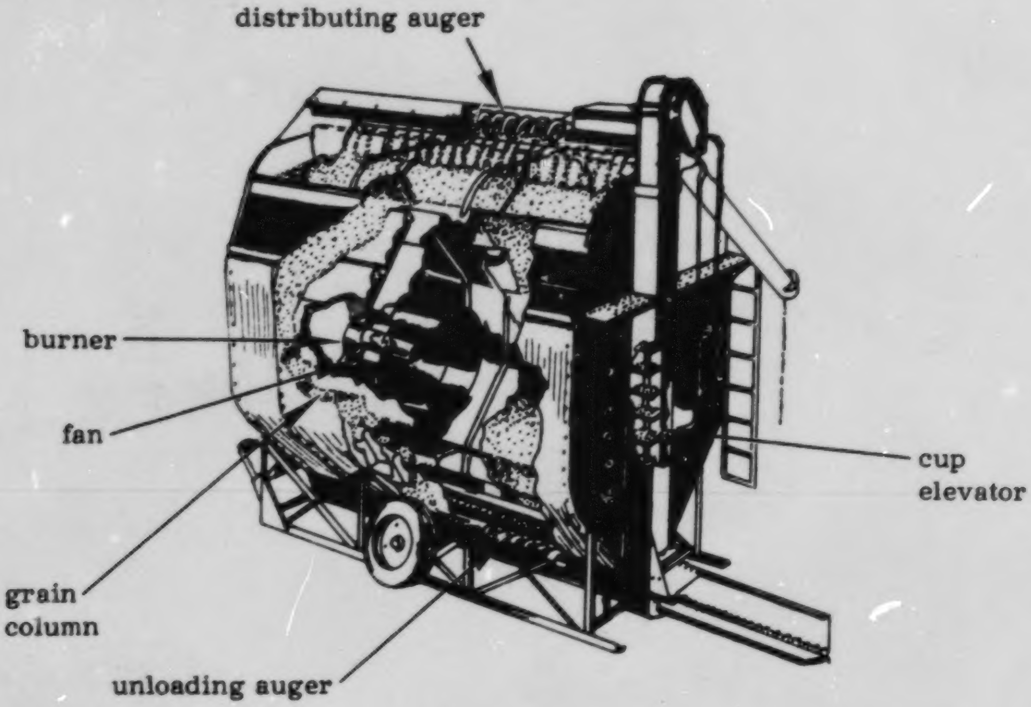


bin with central duct
(part of siding removed)

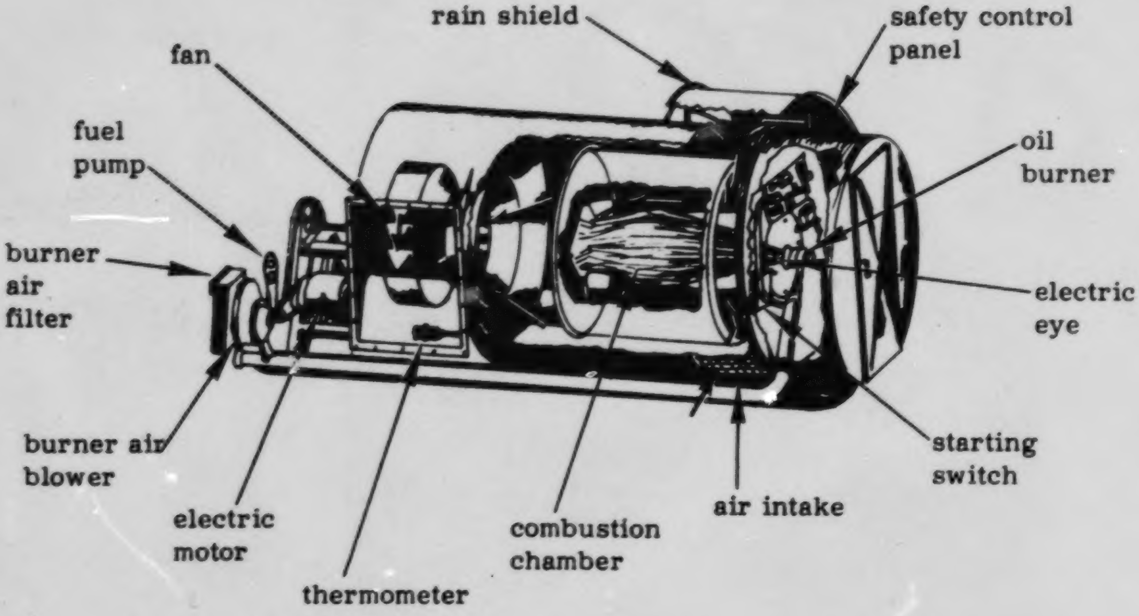


slatted floor barn

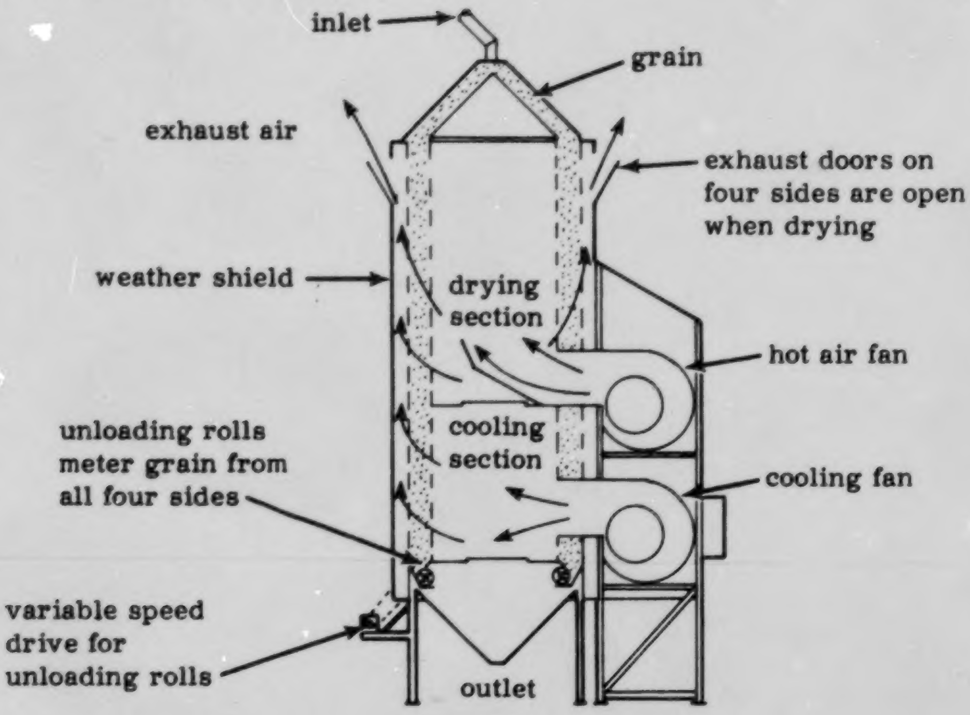
DRYING BINS AND SYSTEMS


distributing auger
burner
fan
cup elevator
grain column
unloading auger

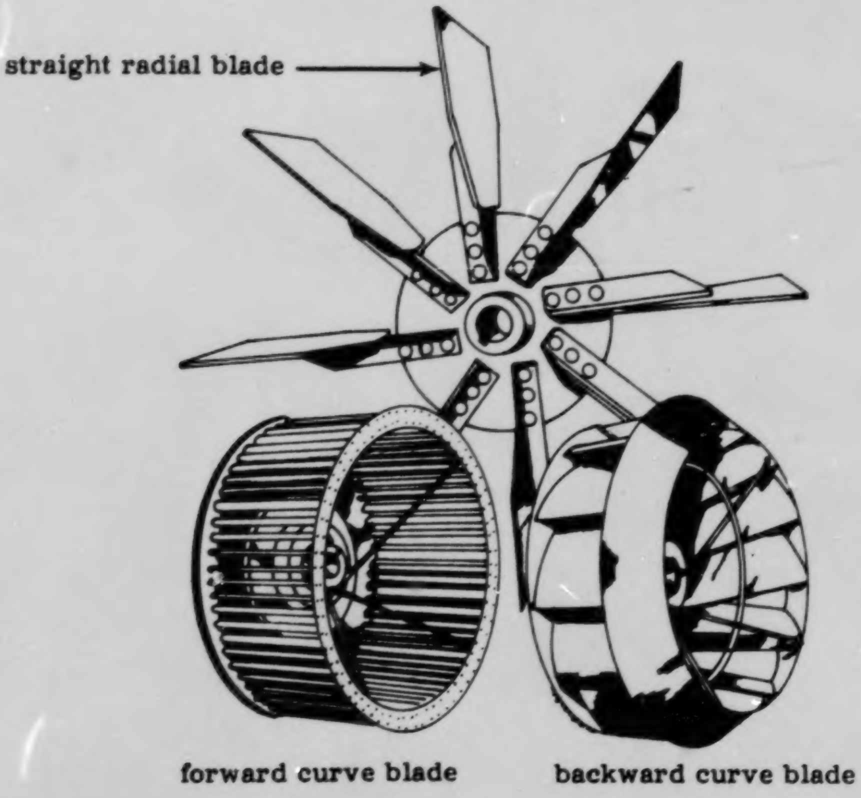
CUTAWAY VIEW OF BATCH DRYER


rain shield
safety control panel
fan
fuel pump
oil burner
burner air filter
electric eye
burner air blower
starting switch
electric motor
air intake
combustion chamber
thermometer

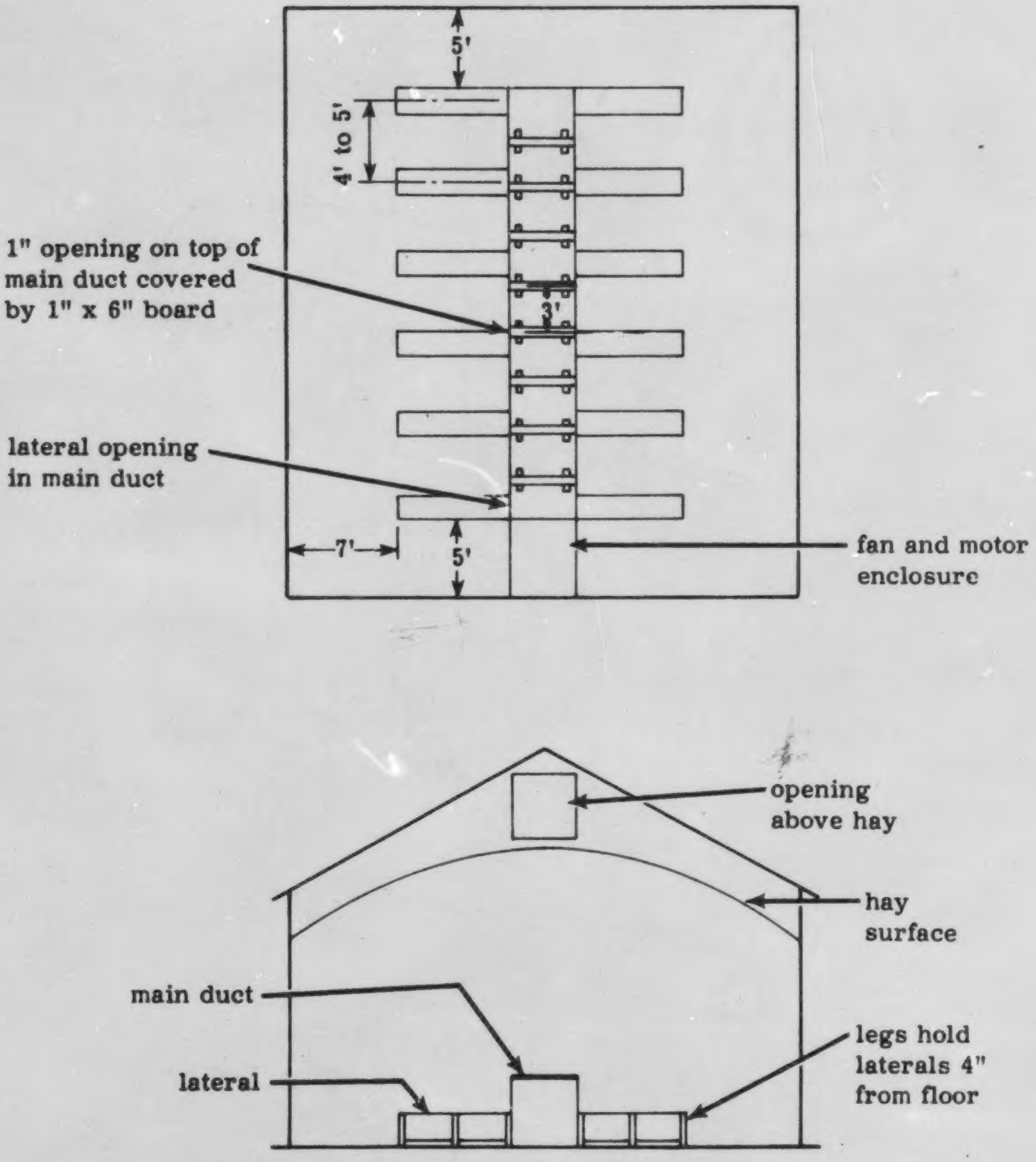
SECTIONAL VIEW OF A HEAT EXCHANGER


inlet
grain
exhaust air
exhaust doors on four sides are open when drying
weather shield
drying section
hot air fan
unloading rolls meter grain from all four sides
cooling section
cooling fan
variable speed drive for unloading rolls
outlet

CONTINUOUS-FLOW COLUMN DRYER


straight radial blade
forward curve blade
backward curve blade

TYPES OF FAN BLADES USED WITH CENTRIFUGAL FANS


5'
4' to 5'
1" opening on top of main duct covered by 1" x 6" board
3'
lateral opening in main duct
7'
5'
fan and motor enclosure
opening above hay
hay surface
main duct
lateral
legs hold laterals 4" from floor

ARRANGEMENT OF THE CENTRAL DUCT WITH LATERALS FOR DRYING LONG LOOSE HAY

Assignment Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Special Equipment

TOPIC: Forage Blowers

OBJECTIVE: To develop an understanding of the specifications, operation, lubrication, trouble-shooting, and service of a specific forage blower.

REFERENCES:

1. Operator's Manual for forage blower from implement company
2. Farm Machinery and Equipment, pp. 319-327
3. Machines for Power Farming, pp. 460-461
4. Information Sheet, "Forage Blowers"

QUESTIONS OR ACTIVITIES:

1. Study the General Specifications section of the operator's manual, with special emphasis being given to:
   (a) Auger diameter
   (b) Blower fan
   (c) Fan speed
2. Study the specific lubrication requirements of the forage blower, with special emphasis on daily lubrication.
3. Study the Operation section of the operator's manual and be able to describe the operation of the forage blower.
4. Study the Trouble-Shooting section or Service section of the operator's manual to understand how to service the forage blower.
5. Describe the main parts of a blower unit.
6. List the main parts of a forage harvester with blower attached.
7. List the two major types of blowers.
8. What is the purpose of an over-running clutch on the PTO-driven unit?
9. List the main parts of a silo forage blower.

Information Sheet
on
FORAGE BLOWERS

The forage blower is usually attached to the forage machine. The blower fan may be made up of six blades fastened to a solid plate wheel or hub. These paddle blades turn very close to the blower housing. Their function is to separate the crop for easy feeding. The delivery spout may be round, square, or rectangular in shape. It also may be curved or almost straight. It will usually be equipped with a swivel deflector at the top in order that the operator can deflect the flow of feed to any part of the wagon or forage box.

Blowers receive their power either from a mounted gasoline engine or from the tractor PTO. The PTO unit has an over-running clutch that permits the operator to shift into gear after the cutting mechansim is speeded up. After the PTO shaft is disengaged the over-running clutch permits the blower to remove the forage from the machine.

The forage harvester-blower and the silo forage blower differ mainly in their component parts. The blowers of both machines are similar and work on the same principle. The forage harvester-blower consists of:

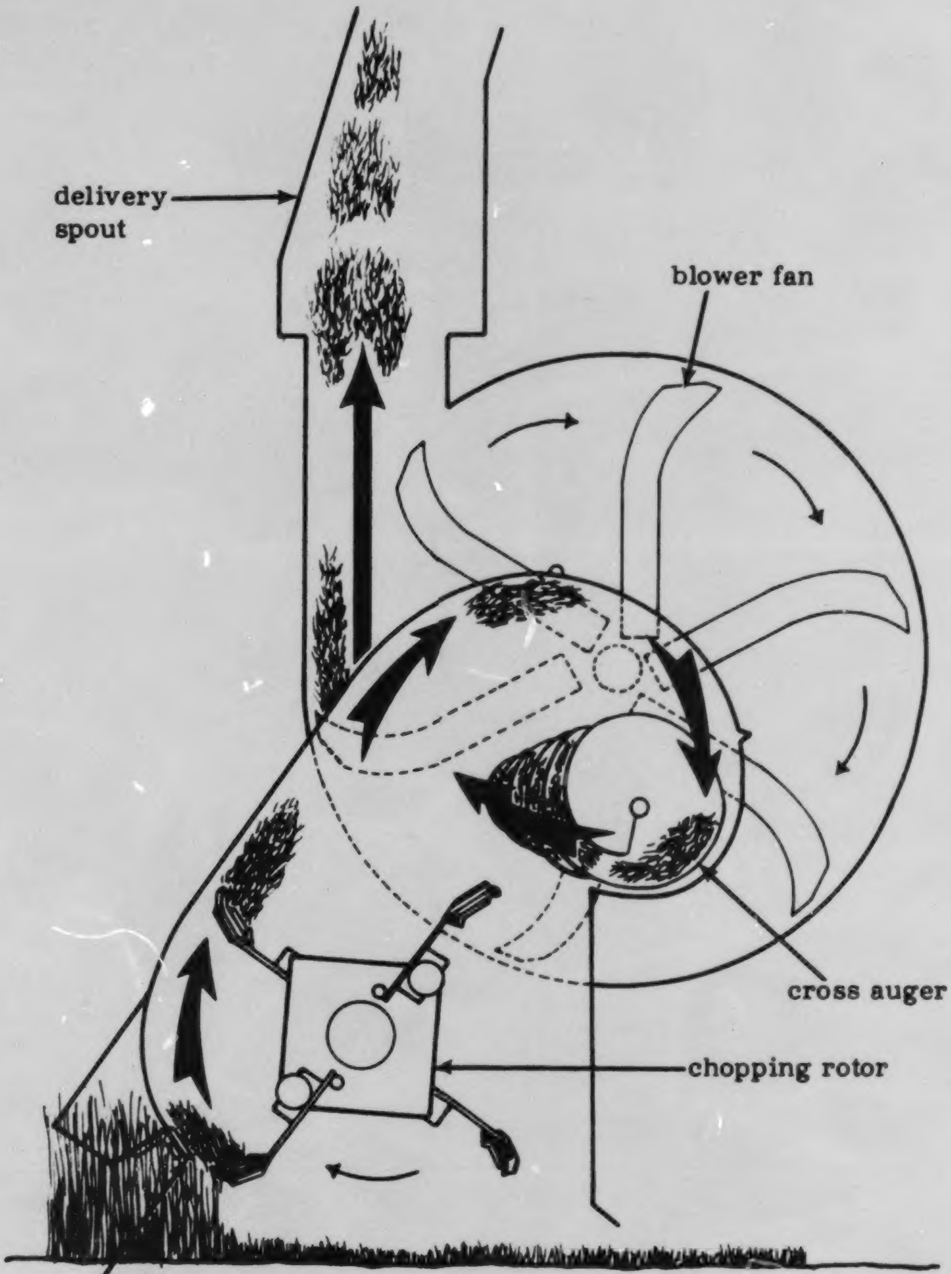
1. Cutter bar
2. Pick-up attachment
3. Chopping rotor
4. Cross auger
5. Blower fan
6. Delivery spout

The silo forage blower consists of:

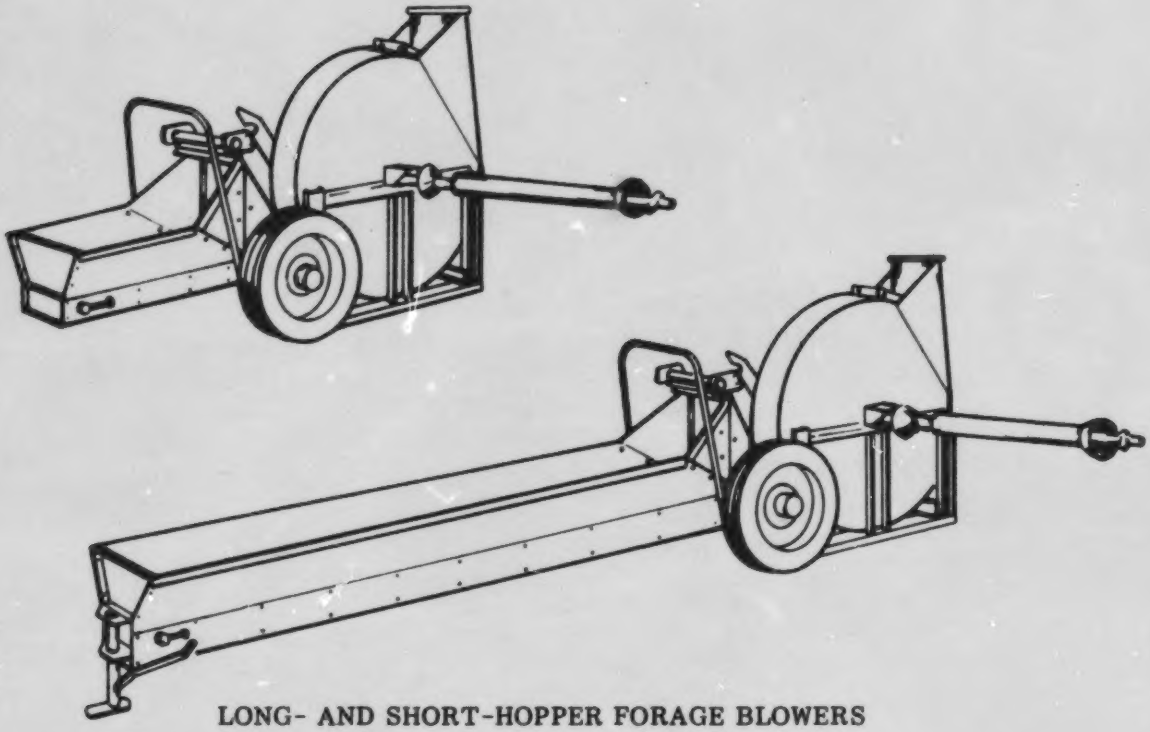
1. Conveyor unit
2. Auger and retarder
3. Blower fan
4. Delivery spout

On most machines the blower is considered a separate unit.

When operating a blower, there is one best speed for the machine. It will usually be given in the operator's manual. If operated at too slow speed, it will tend to clog and waste power.

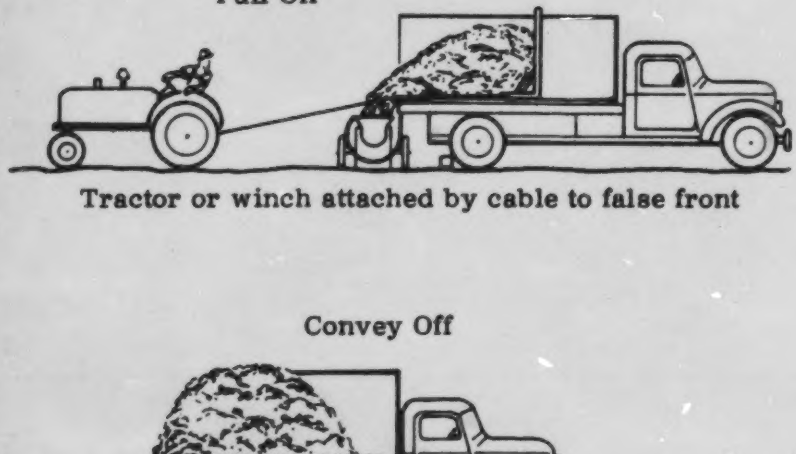

delivery spout
blower fan
cross auger
chopping rotor
shear bar
Direction of travel

ACTION OF FLAIL KNIVES CUTTING FORAGE AGAINST SHEARBAR



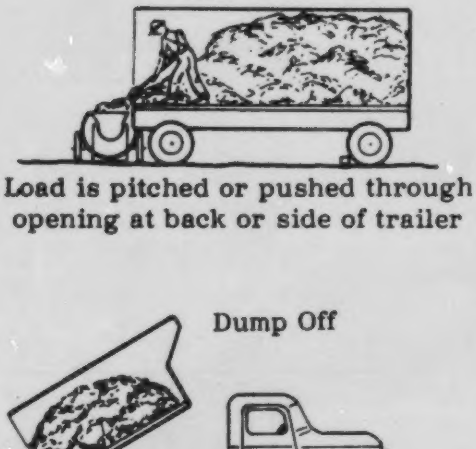
LONG- AND SHORT-HOPPER FORAGE BLOWERS

Pull Off



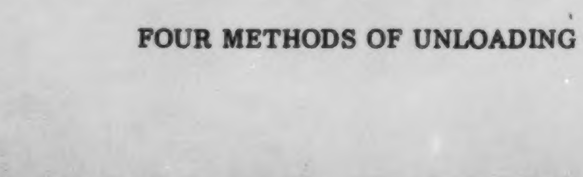
Tractor or winch attached by cable to false front

Pitch & Push Off



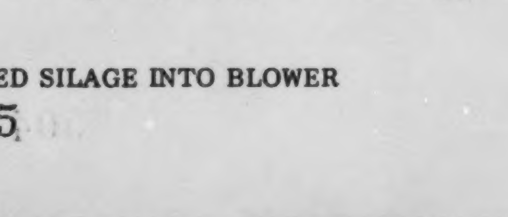
Load is pitched or pushed through opening at back or side of trailer

Convey Off



Power driven unloading conveyor built into truck or trailer

Dump Off



Tilting body dumps load into hopper

FOUR METHODS OF UNLOADING CHOPPED SILAGE INTO BLOWER

Assignment Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Special Equipment

TOPIC: Tractor-Mounted Loaders

OBJECTIVE: To develop an understanding of the specifications, operation, lubrication, trouble-shooting, and service of a specific farm loader.

REFERENCES:

1. Operator's Manual for farm loader from implement company
2. Farm Machinery and Equipment, pp. 447-453
3. Machines for Power Farming, pp. 280-287
4. Information Sheet, "Tractor-Mounted Loaders"

QUESTIONS OR ACTIVITIES:

1. Study the General Specifications section of the operator's manual, giving special emphasis to:
   (a) Bucket capacity
   (b) Lifting capacity
   (c) Lifting height
   (d) Type lift cylinder
2. Study the specific lubrication requirements of the farm loader, with special emphasis on daily lubrication.
3. Study the Operation section of the operator's manual and be able to describe the operation of the farm loader.
4. Study the Trouble-Shooting section or Service section of the operator's manual to understand how to service the farm loader.
5. Describe the most commonly used loader.
6. Define lifting and carrying capacity.
7. List the parts of a loader hydraulic system.
8. What determines the speed at which the loader operates?
9. How is the bucket capacity determined?
10. List the main parts of a loader.

Information Sheet
on
TRACTOR-MOUNTED LOADERS

Tractor-mounted loaders that were first designed to load manure have since revolutionized the handling of heavy materials around the farm. Due to their versatility, they are one of the handiest pieces of equipment to have around.

Most loaders are front mounted with one boom on each side of the tractor. This front mounting makes visibility of the job better. Most of these loaders are hydraulically operated. Loaders may be equipped with buckets for manure or hay, or they may be equipped with a hook for moving machinery.

Loader capacities are stated in three ways. Lifting capacity is lifting of a maximum load to the complete height of the loader. The carrying capacity is considered the weight in pounds that can be lifted three feet from the surface and moved to another location. Loader bucket capacity is normally expressed in cubic feet or cubic yards.

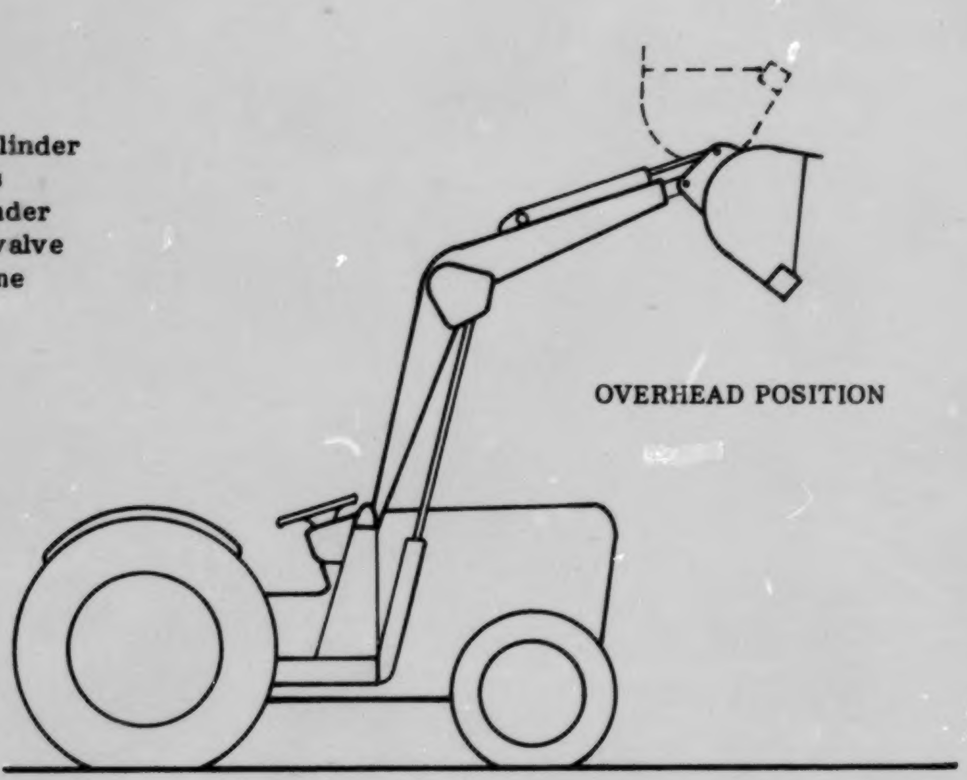
Loader operation is controlled by the hydraulic system. It consists of piping, reservoir tank, pump, shutoff valve, spool valve, relief valve, piston, and cylinder. The capacity of the hydraulic pump more or less determines the speed of operation. It is measured in gallons per minute at a certain speed and at specified pounds per square inch pressure.

Loader speed is measured in cycle time up, cycle time down, and the tilting speed of the bucket. Cycle time up is the total time to move a load from ground level to maximum height. Cycle time down is that required to move the load from maximum height to ground level. Bucket tilting speed is the time required to move a bucket from maximum load position to maximum dumping angle.

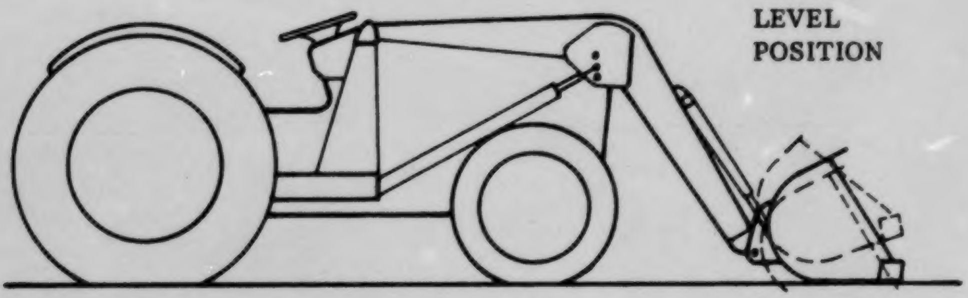
Loader components vary with the type. Some of the parts common to most are:

1. Bucket
2. Damp cylinder
3. Lift arms
4. Lift cylinder
5. Control valve
6. Side frame

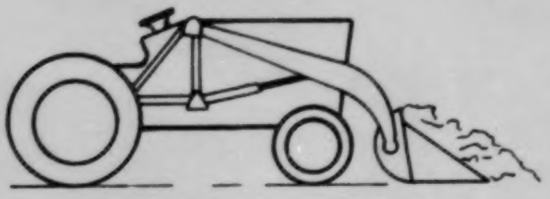
1. Bucket
2. Dump cylinder
3. Lift arms
4. Lift cylinder
5. Control valve
6. Side frame

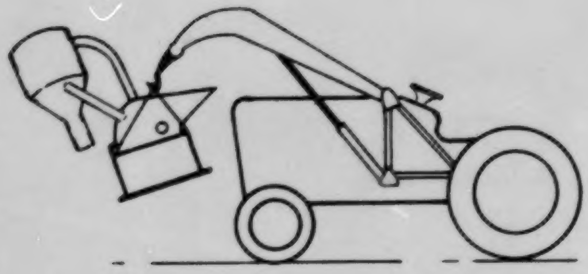


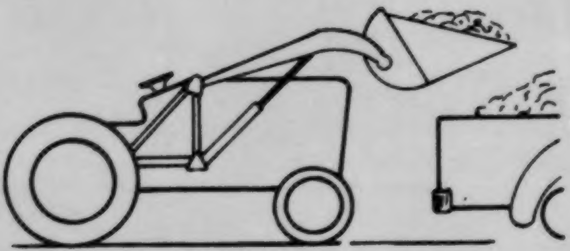
OVERHEAD POSITION

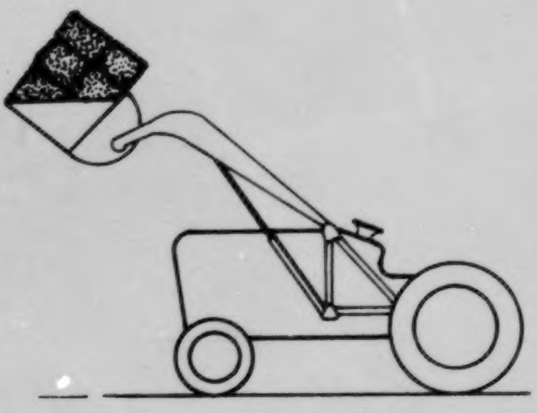


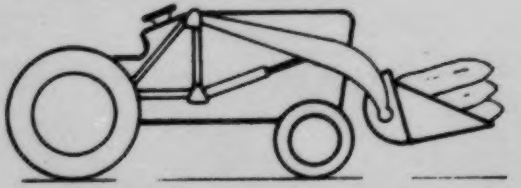
GROUND LEVEL POSITION

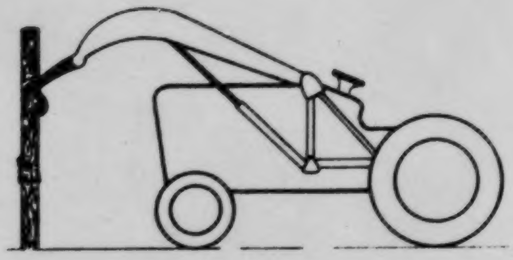

Move Dirt


Lift Heavy Objects


Load Trucks


Lift Bales


Tote Bags


Pull Posts

POWER LOADER JOBS

Assignment Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Special Equipment

TOPIC: Chain Saws

OBJECTIVE: To develop an understanding of the specifications, operation, lubrication, trouble-shooting, and service of a specific portable power saw.

REFERENCES:

1. Information Sheet, "Chain Saws"
2. Operator's Manual for chain saw from implement company

QUESTIONS OR ACTIVITIES:

1. Study the General Specification section of the operator's manual, giving special emphasis to:
   (a) Number of cylinders
   (b) Cooling
   (c) Starting
   (d) Type
   (e) Speed
   (f) Weight

2. Study the specific lubrication requirements of the portable saw, with special emphasis on daily lubrication.
3. Study the Operation section of the operator's manual and be able to describe the operation of the portable power saw.
4. Study the Trouble-Shooting section or Service section of the operator's manual to understand how to service the portable power saw.
5. What is the difference between the power source of a chain saw and that of a lawn mower?
6. List the events that take place in a two-cycle engine.
7. What is the safe RPM operating range of a chain saw?
8. What are two key words in the proper care of a saw?

Information Sheet
on
CHAIN SAWS

The chain saw is a machine widely used to fell, limb, and buck trees. Lightweight saws are used to clear brushy land and cut such materials as poles and large construction timbers.

The power source of the chain saw is similar to that of lawn mowers and most garden and farm tractors. All of these machines have reciprocating internal combustion engines. Power is derived from burning a mixture of refined petroleum products and air. The combustion of these fuels causes pressure to be applied to a piston and a connecting rod which turns the shaft in the engine. Combustion is caused by timed electric sparks that ignite the fuel mixture.

There are five events that take place in the two strokes of a two-cycle engine. These two strokes take place in one revolution of the crankshaft. The events are intake, compression, ignition, power, and exhaust.

The chain saw engine is lubricated by a fuel-oil mixture (oil makes up a portion of the fuel). As the piston moves downward, the crankcase is pressurized, causing oil to condense on the bearing surface. The fuel mixture enters the combustion chamber on the upward movement of the piston. The cylinder wall, piston, bearings, and rings are lubricated by the mixture.

Chain saw drive - Today, about 1 out of every 10 chain saws sold is a gear drive model. Gear drive saws can be used with a bow guide bar, but these are normally used with larger models which have 3 foot or longer guide bars. The gear drive is used to lower the chain speed and permit a larger "bite" into the wood due to the use of heavy-gauge, large pitch chains. For this reason a gear drive saw produces less guide bar and chain wear than other types.

The direct drive chain saw has a lower initial cost and is the most popular. In a direct drive, the engine crankcase is attached directly to the chain driven sprocket. Less operator fatigue is experienced with a direct drive, because it is lightweight, highly maneuverable, and easy to carry. High chain speeds and light weight make it suitable for limbing and topping operations. The clutch of a direct drive saw will slip if the chain speed is reduced by heavy cutting pressure or overfeeding. Recent improvements such as the new roller-nose bar have increased the life and usefulness of direct drive saws.

Chain saw clutch - Most chain saws use a centrifugal-type clutch, usually with 2, 3, or 6 shoe elements rotating inside a drum. When the engine is idling, the shoes are held in by clutch springs strong enough to keep the shoes from touching the

Chain Saws
(Information Sheet continued)

drum. However, when the crankshaft rotates at a high RPM, the shoes (by centrifugal force) move out against the spring tension and engage the clutch drum. When the clutch drum turns, the chain saw moves. The clutch is designed to slip any time an instantaneous high pressure is applied. This prevents damage to the engine.

Chain saw engines - Most chain saw engines are not equipped with a governor to control engine speed. It is up to the operator not to abuse the engine. Usually, applying a saw to the wood is sufficient to keep the engine from overspeeding. Direct drive saws normally have a safe operating range of from 6,000 to 9,000 RPM under varying load conditions. Serious engine damage can occur if the carburetor mixture is on the lean side and the engine is run wide open without a load.

Chain oiler - Chain saws may be purchased with either a manual oiler system or an automatic oiler system. The trend now is to manufacture models with automatic chain oiler systems. Automatic oiler systems add $10 to $20 to the cost of a saw. The automatic oiler affords protection if the operator does not know how much to oil, forgets to oil regularly, or is not generous enough with the oil.

Other chain saw features such as the ignition grounding switch, choke, trigger lock, and other operating controls should be grouped in such a manner that the operator need not loosen his hold on the saw to reach any control. Handles and handle bar should be comfortable and easy to hold.

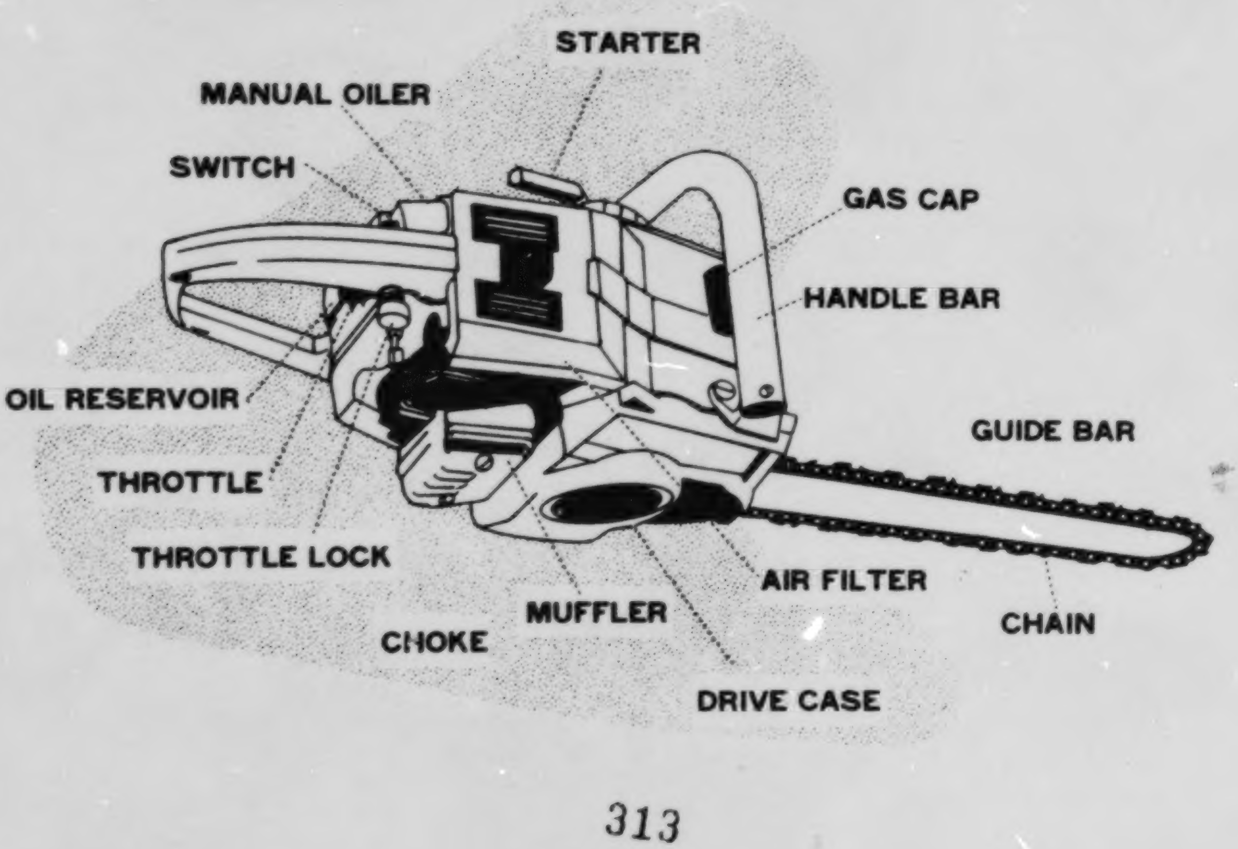
Chain saw features - The best kind of saw to use depends on the type and size of trees to be harvested and whether the harvesting plan calls for partial cutting or clear cutting. It also depends on the terrain, accessibility of trees to be harvested, and the ease or difficulty with which an area can be worked.

Chain saw manufacturers have numerous sizes and models of saws on the market. Today, saws designed for felling large trees weigh only 20 to 30 pounds. Many saws for felling small trees and for limbing and bucking weigh less than 14 pounds. Six-pound saws are used for cutting brush and limbing.

The main features are: drive case, guide bar, chain, handle bar, starter, manual oiler, switch, oil reservoir, throttle, throttle lock, choke, and muffler.

Chain Saws
(Information Sheet continued)

Maintenance is a key word for chain saw operation. Proper maintenance cannot be separated from proper operation. The saw is being maintained if during operation the enemies of the chain saw - dirt, neglect, abuse - are avoided. At the end of each working day, check for loose nuts, screws, and wires. Tighten all loose parts and replace any damaged parts. If an air hose is available, blow out sawdust and dirt caked in the hard-to-get-at places. Keep the entire saw clean. Do not allow the cylinder fins, air filter, muffler, tank, or cover to become plugged with dirt, sawdust, or other foreign material. Keep a supply of clean air filters and change them whenever necessary. Keep the fuel and oil filters clean at all times. Never put dirty fuel or used oil into the saw. Maintain a careful watch on the condition of the chain and bar. Be sure lubrication is adequate to keep the chain oiled to prevent overheating.


STARTER
MANUAL OILER
SWITCH
GAS CAP
HANDLE BAR
OIL RESERVOIR
GUIDE BAR
THROTTLE
THROTTLE LOCK
AIR FILTER
MUFFLER
CHAIN
CHOKE
DRIVE CASE

Assignment Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Special Equipment

TOPIC: Feed Distribution Equipment

OBJECTIVE: To develop an understanding of the specifications, operation, lubrication, trouble-shooting, and service of feed distribution equipment.

REFERENCES:

1. Operator's information for feed distribution equipment from supply company
2. Information Sheet, "Feed Distribution Equipment"

QUESTIONS OR ACTIVITIES:

1. Study the general specifications section of the operator's information, giving special emphasis to the following:
   (a) Installation
   (b) Capacity
   (c) Maintenance requirements

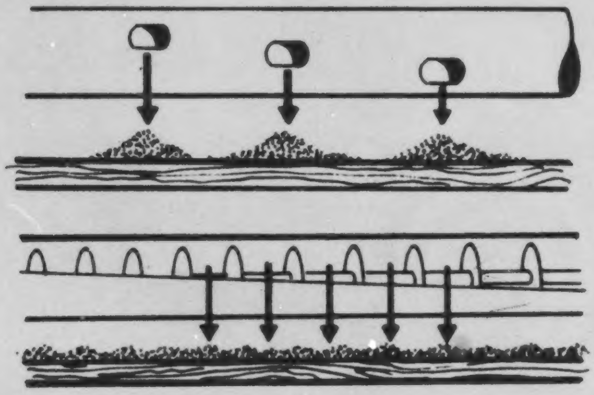
2. Study the information on the operation of the feed distribution unit.
3. List the types of electric bunk distributors.
4. What is a flip board?
5. Why is a swinging conveyor system used?
6. Why is there a fast return stroke on the shaker trough?
7. Which feed distribution system is the oldest?
8. Why are bunk-feeder wagons used?

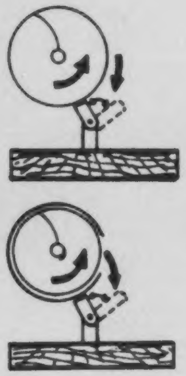
Information Sheet
on
FEED DISTRIBUTION EQUIPMENT

Equipment is necessary to handle feedstuffs after storage and processing. It must be distributed to feed troughs with a minimum of labor and use of equipment. Many large feeding units use an automatic feeding and conveying system. These systems range from hand operated electrical switches to completely automatic operated switches.

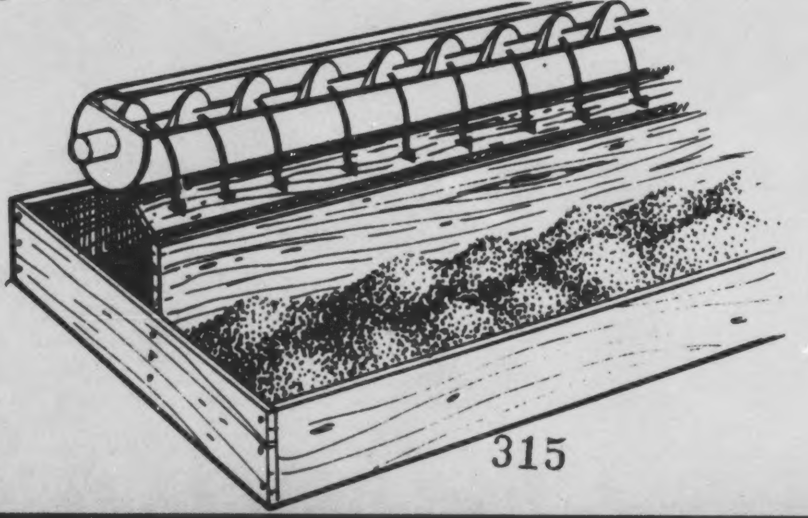
The handling of feed products requires that materials be moved in all directions. Good utilization of a wide variety of component equipment is required to get full efficiency from the distribution system. There are several types of electric bunk distributors in operation. They are as follows:

Proportional-Drop-Auger - There are two kinds, one with holes or slots on the sides, and the other with one side partly open. The first type has the openings gradually lower on the side. Another version has adjustable-size holes. Two to four lots of cattle may be fed by using the optional Flip Board.



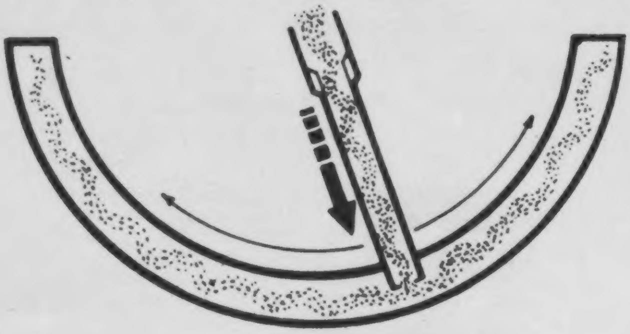


Revolving-Tube Auger - This auger tube is open on top. When feed reaches the outer end, the entire tube revolves and drops feed along the full length of the bunk. Flip boards may also be used to feed two lots of cattle.

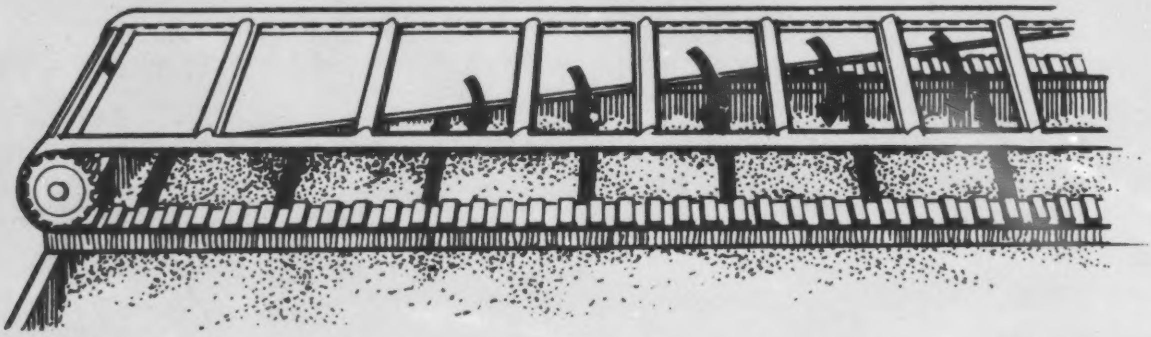


Feed Distribution Equipment
(Information Sheet continued)

Swinging Conveyor - This feeder requires a semi-circular bunk. The feeding conveyor pivots at one end and travels back and forth to fill the bunk.

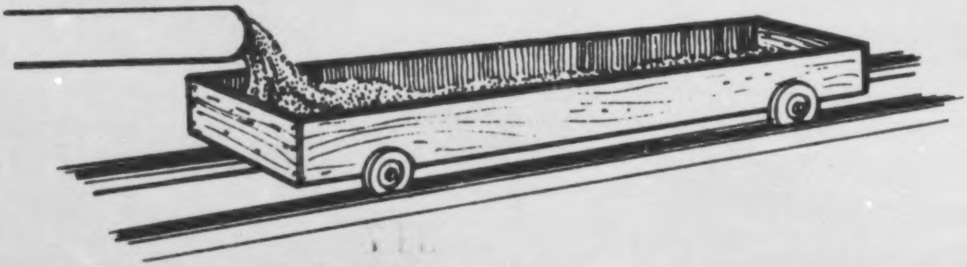


Tapered-Bed Chain Conveyor - A double-chain conveyor pulls silage or other feeds over a bed that is tapered. Feed on the right side drops off the bed and feed on the left side goes all the way to the end, so feed is gradually dropped off over the entire length of bunk. This unit will fit existing bunks fairly easy.



Shaker Trough - The entire metal trough oscillates back and forth, with a faster return stroke so the trough slips backward under the feed. The forward stroke carries the feed with the trough. Anything from bales to ground feed can be handled. The cattle eat directly from the trough.

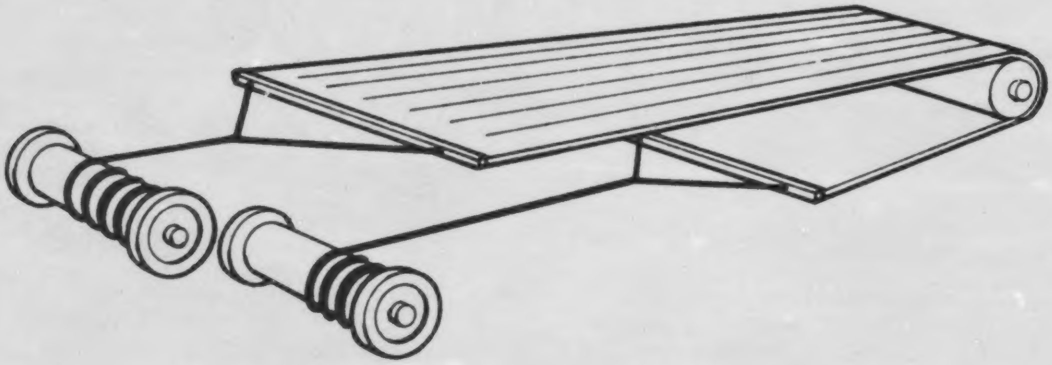
Cost is the big disadvantage, since it includes the bunk itself as well as its drive and suspension system. Filling is progressive from one end, which might cause crowding.



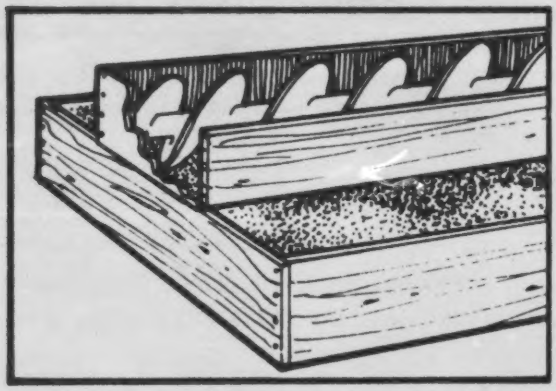
Feed Distribution Equipment
(Information Sheet continued)

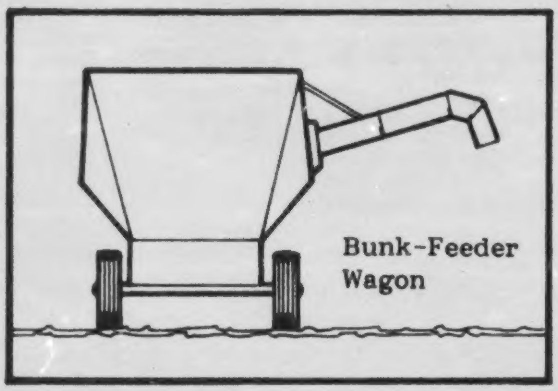
Reversible Belt - The drive end is located away from the silo, and the filled belt is pulled out to the end.

The feed bunk must be specially built for this unit. Cost is competitive with auger feeders, and may be less for longer bunks.



Open-Bottom Auger - This is one of the earliest bunk feeders. It fills the bunk progressively from the silo end. It is the least expensive of the auger type, but requires the most power to operate. The amount of feed in the bunk is regulated by the auger height in the trough.





Bunk-Feeder Wagons - Most bunk-feeder wagons can transport, mix, and unload. Thus, with slight adaptation, these units can be made to perform a variety of tasks.

Fence-line bunk feeding and field forage handling are the key targets for bunk-feeder wagons.

Automatic feeding and conveying systems are the answer to getting the most from all resources, including present labor. The equipment selected must be fully utilized if maximum returns on investment are to be realized.

Answer Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Introduction

TOPIC: The Machinery Industry and Its Importance in American Agriculture

1. Great improvement began to appear in the 1800's with the development of soil preparation, planting, cultivating, and harvesting equipment.

2. a. Moldboard plow - 1797
   b. Reaper - 1831
   c. Mower - 1822
   d. Baler - 1853
   e. Combine - 1880
   f. Cultivator - 1863
   g. Grain drill - 1840

3. The animal power period began about 1850 and ended about 1918.

4. Since 1830 powered equipment has reduced man-hours 97 percent to produce 20 bushels of wheat on one acre. At the turn of the century 84 percent more time was required to produce the 20 bushels of wheat than is required today.

5. a. Wheat
   b. Rice
   c. Grain sorghum
   d. Corn
   e. Dairy products
   f. Soybeans
   g. Cooking oils

6. a. The farmer can produce more food and fiber for himself and other people.
   b. Farm workers have decreased and production has increased.
   c. The size of farms is increasing.
   d. Today's farmer has more time, better living conditions, and modern equipment.
   e. Today's farmers are better educated.

7. Forty percent of the farms produce about 87 percent of all the food and fiber.

Answer Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Introduction

TOPIC: Agricultural Mechanics as an Occupation

1. It is estimated that several thousand skilled agricultural equipment technicians are needed annually by manufacturers, distributors, and farm machinery service and repair businesses.

2. a. 955 Manufacturing Plants
   b. 16,000 Dealerships
   c. 80,000 Employees

3. The average dealership earns about $300,000 from sales of equipment and machines.

4. Mechanic, partsman, welder, bodyman, machinist, assistant partsman, welder-repairman and welder-painter

5. a. Assemblyman
   b. Shop Worker
   c. Deliveryman
   d. Set-Up and Deliveryman
   e. Mechanic's Helper
   f. Pick-Up Man
   g. Welder's Helper

6. An equipment technician must have an adequate education in order to fulfill the various assignments in the equipment division of a dealership. For example, a repairman must be able to use a service manual, keep records, and file reports.

7. The repairman is usually responsible to the service manager or supervisor for both shop and field assignments.

Answer Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Introduction

TOPIC: Safety - Shop and Equipment

1. a. Eighty-six to eighty-eight per cent
   b. Ten per cent

2. They protect the employee, tools, equipment, and building.

3. There are about 2,000,000 disabling injuries each year in all major industries, and about 290,000 of these are in the agricultural industry.

4. a. Habits
   b. Skills
   c. Knowledge
   d. Safe work attitude

5. a. Shop benches are clean.
   b. Shop floor is clean.
   c. Fire hazard wastes removed from the shop.
   d. Materials and supplies restored to their proper place.
   e. Tools and reconditioning equipment are kept in the proper place.

6. a. Welding helmet
   b. Gloves
   c. Protective clothing

7. a. Wrestling
   b. Pushing
   c. Tripping
   d. Hurrying on project
   e. Playing with tools
   f. Being idle
   g. Running
   h. Littering floor
   i. Loud talking
   j. Disregarding rules

8. a. Improper handling of the tools
   b. Using the wrong tool for the job
   c. Using damaged tools
   d. Using dull edged tools
   e. Using greasy or dirty tools

9. a. Check the three-prong plug for damage.
   b. Check the cord for damage and keep it in the proper place when using the tool.
   c. Operate tools with dry hands.
   d. Remove the cord and plug from the outlet by grasping plug.
   e. Place the tool in the proper location for storage.

Answer Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Introduction

TOPIC: Mechanical Tools - Identification and Use

1. a. Standard
   b. Phillips
   c. Clutch
   d. Offset
   e. Starting

2. a. Hold parts
   b. Crimping connections
   c. Cutting wire
   d. Bending cotter pins

3. a. Ball peen hammer
   b. Soft hammer
   c. Sledge hammer
   d. Blacksmith's hammer

4. a. Single Cut - One row of teeth on blade.
   b. Double Cut - Two rows of teeth on blade.
   c. Rasp Cut - Independent teeth.
   d. Curved Tooth - Single curved row of teeth.

5. a. Cutting off rivet heads
   b. Cutting bolts
   c. Splitting nuts
   d. Cutting thin metal

6. a. Start rivets, bolts, and pins out of holes
   b. To drive rivets, bolts, and pins from holes
   c. Mark parts when disassembling and scarring metal for drilling
   d. Align parts and prevent parts from shifting

7. Taps are used to cut internal threads and dies cut external threads.

8. a. Sizes 1/16 to 1/3 inch by 32nds.
   b. Numbers 1 to 60
   c. Letters A to Z

9. a. The jaws of the external puller are hooked behind the gear or wheel and the screw is placed on the shaft or axle.
   b. The legs of an internal puller are placed on the stationary part of the machine and the puller jaws grasp the bearing from the inside. The puller screw is turned to force the bearing out.
   c. A broken stud (bolt) is pulled by dropping the stud puller over the broken stud and turning the tee.

UNIT: Introduction
TOPIC: Mechanical Tools - Identification and Use
(Answer Sheet continued)

10. a. An open end wrench is one of the most commonly used in repair work. The opening is measured according to the size of the nut. Wrench heads are set straight and at various angles.
    b. Socket wrenches are also commonly used on repair work. They are available in many sizes. Usually the most common are 6 to 12 point openings and 1/4 to 2 inch drive size. Depths of the sockets are standard and deep. There are many types of handles for the sockets.
    c. Box end wrenches are available with a 6 to 12 point opening. The wrench heads are straight and offset.
    d. Combination open and box end wrenches have one end closed and the other open. Both ends are usually the same size.
    e. The flare nut wrench has 6 to 12 point openings. The cut out part of this wrench will allow it to be slipped over tubing and tubing nuts.
    f. A torque wrench is either measured in inch or foot pounds. It measures resistance to turning.
    g. Other wrenches used in equipment repair work are adjustable, pipe, allen, fluted, and spanner.

11. a. Micrometers
    b. Gauges
    c. Calipers
    d. Dividers

Answer Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Introduction

TOPIC: Use of Holding Devices, Jacks, Lifts, and Hydraulic Presses

1. a. Hydraulic
   b. Ratchet teeth
   c. Screw type

2. a. Lifting
   b. Pushing parts in line or out of line
   c. Bending metal parts on equipment

3. a. Raise front, rear, and side of equipment
   b. Move machine or equipment in close quarters

4. a. Body
   b. Control valve
   c. Saddle
   d. Handle
   e. Foot pump
   f. Rollers

5. a. Hoist mounted on "A" frames, cranes, or stationary I-beams
   b. Hydraulic presses
   c. Repair stands
   d. Portable hydraulic units

Answer Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Introduction

TOPIC: Use of Equipment Manuals

1. a. Operator's manual
   b. Service manual
   c. Special Shop Service manual

2. To cause the machine to function properly and lengthen the life of it

3. To be used as a guide for making repairs and adjustments on equipment

4. Information is given on disassembly, repair, and assembly of parts.

5. Usually a series of like machines are given in a shop manual. An operator's manual deals with only one machine or piece of equipment.

6. A skilled mechanic

7. General operation and maintenance manuals which do not refer to any specific brand name of machine and equipment

8. An operator of the equipment and the equipment owner

Answer Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Introduction

TOPIC: Equipment Inspection

1. Adequate time is needed to make a thorough inspection. The machine should be cleaned completely before inspection. It may be necessary to order repair parts. Major repairs may take several weeks.

2. a. Name of machine
   b. Make of machine
   c. Model and type of machine
   d. Date of inspection
   e. Conditions of parts or assembly
   f. Name of parts or assembly
   g. Type of work or job
   h. Part of parts needed
   i. Catalog number

3. a. Disk plows, tillers, and disk harrows
   b. Planters
   c. Moldboard plows
   d. Cultivators
   e. Mowers
   f. Balers
   g. Combines
   h. Sprayers

4. Inspect the plow share for sharpness and the plow bottom and side for suction. Check furrow wheel bearing, plow beams, braces, hitches, pivots, and linkage for wear and/or distortion.

5. A combine is made up of many moving parts and many of these parts operate independently of each other; therefore, all parts in the mechanism must function properly.

6. A good coat of paint protects the metal and other material against heat, moisture, and chemical reactions when used with or around chemicals found in fertilizers, insecticides, herbicides, or fumicides.

7. a. Lack of knowledge about the functioning of equipment parts

UNIT: Introduction
TOPIC: Equipment Inspection
(Answer Sheet continued)

- b. Lack of time to perform a complete inspection
- c. Needs to keep the equipment operating
- d. Expects dealer to inspect the equipment, especially if it is still in warranty
- e. Lack of tools to make a thorough inspection

Answer Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Introduction

TOPIC: Fasteners Used on Equipment

1. a. Bolts
   b. Screws
   c. Rivets
   d. Pins
   e. Keys

2. a. Machine
   b. Carriage
   c. Stove
   d. Stud
   e. Hanger

3. a. Name
   b. Type of head
   c. Type of thread
   d. Length
   e. Diameter
   f. Finish

4. a. National Coarse (NC)
   b. National Fine (NF)

5. a. Square head
   b. Hexagon head
   c. Slotted head hexagon
   d. Castle
   e. Cap
   f. Speed
   g. Wing

6. a. External tip edge
   b. Split plain ring
   c. Internal tipped edge

7. a. Slotted head
   b. Hexagon slotted head
   c. Phillips
   d. Prince
   e. Spline socket
   f. Clutch

8. Rivets are used mainly to hold thin pieces of metal together, whereas bolts can be used to bolt either thin or thick metal parts together or bolt to other types of thick material. It is assumed that metal fastened with rivets is not be disassembled.

9. a. Studs fasten metal or metal or other material to metal by inserting one end of the stud in a tapped hole and using a nut on the other end.
   b. Cotter keys are used mainly as fasteners by inserting the key through a hole on a shaft with a slotted head nut (castellated nut).
   c. Lock washers are placed between the nut and the metal to lock the nut in place.
   d. Setscrews are used mainly to lock pulleys on shafts.

Answer Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Introduction

TOPIC: The Function and Types of Bearings Used on Equipment

1. Friction bearings are split, solid, and thrust. Antifriction bearings are straight roller, spherical roller, tapered roller, needle roller, and deep groove roller.
2. Bearings reduce wear and friction by holding the various moving parts in position.
3. Most friction bearings are made to support radial loads.
4. The antifriction bearing uses a roller element of some type to reduce friction.
5. The parts are: ball or roller, outer ring, shoulders, inner ring, cage, bore, face, and race.
6. Most bearings are identified by a code which includes the type, bore, O.D., and width.
7. Friction bearings may be made up of the following parts: back, lining, flanges, oil grooves, oil holes, location lug, and parting edges.
8. Common defects of antifriction bearings are: spalling, brinelling, over heating, cracked rings, dented shields, damaged cage, and electrical pitting.
9. Antifriction bearings are either removed by a mechanically operated or hydraulic puller, mechanical or hydraulic press, or a hammer and some type of driving tool.
10. Friction bearings require about one-fourth more power to pull than do antifriction bearings.

Answer Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Introduction

TOPIC: Gaskets, Seals, and Sealants for Farm Equipment

1. a. Steel
   b. Aluminum
   c. Copper
   d. Rubber
   e. Asbestos
   f. Cork
   g. Paper
   h. Plastic

2. Gaskets make the joints leakproof, that is, if the parts are drawn together.

3. a. Types of fluid or gas to be confined to an area
   b. Temperature
   c. Smoothness of mating parts
   d. Pressures against parts and gaskets
   e. Form or construction of mating parts

4. a. Steel and asbestos are materials used to make manifold gaskets.
   b. Different types of metallic gaskets (steel, other metal, and asbestos) are used for cylinder heads.

5. Problems encountered in the installation of gaskets include irregular mating surfaces, pressure loss due to bolt torque loss, gasket shrinkage, gasket leaks, and improper gasket size.

6. a. Anytime it is removed from its initial position
   b. When it is cracked, torn, or damaged in any way

7. a. Prevent leaks of fluids and gases
   b. Keep out foreign material at joints and openings
   c. Separate units and parts of machine or equipment

8. a. Withstand certain pressures and heat
   b. Fit the equipment part or parts
   c. Free of damage
   d. Have a number and name to facilitate its selection

9. a. Radial lip seals are used to keep lubricants in systems where moving parts are found. These seals are used on shafts.
   b. Exclusion seals prevent dirt and other foreign material from entering moving parts.

UNIT: Introduction
TOPIC: Gaskets, Seals, and Sealants for Farm Equipment
(Answer Sheet continued)

  c. Ring seals control the movement of lubricants and compression in a cylinder. Ring seals are usually used on pistons.
  d. Face seals are usually used on rotating shafts.

10. Sealants contain liquids and gases and protect equipment against dirt, moisture, and dust. They also furnish a protective coating and can be used to hold gaskets in place.

11. a. Nonhardening
  b. Hardening
  c. Tapes

Answer Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Introduction

TOPIC: Painting Equipment and Machines

1. a. Paint protects metal against corrosion.
   b. Appearance is improved by a good coat of paint.
   c. Paint helps maintain machine value.

2. An accumulation of burnt oil and oily dirt on equipment parts can usually be removed with a scraper and wire brush.

3. An alkaline compound used in 180 to 200 degree F. water is one of the best methods used to clean large parts.

4. This is one of the best ways to remove oil and dirt from parts. A solvent is usually applied to oily areas.

5. a. Air compressor
   b. Putty knife
   c. Emery cloth
   d. Blow torch
   e. Wire brush
   f. Steel wool
   g. Screwdriver

6. The spray gun will cover an area up to twenty-five times faster than a paint brush. The painted area is usually smooth when a spray gun is used.

Answer Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Introduction

TOPIC: Importance of Welding and Identification of Metals

1. a. The welder aids in making repairs rapidly, which is a good insurance during critical periods.
   b. Minor breaks can be repaired before they cause major repair problems.
   c. Metal repair is usually more economical with a welder than bolting or adding new parts.
   d. Jobs other than welding can be accomplished on a piece of equipment.

2. Heat metal for bending, forming, straightening, hardening, tempering, and removing paint and rust on equipment

3. Fusing two or more pieces of metal together by using heat produced from an electric welding machine

4. Electricity is the source of energy for arc welding, whereas oxygen and acetylene furnishes the energy to fuse metal by using an oxyacetylene unit.

5. a. The letter E represents the electrode for electric arc welding.
   b. The number 60 is the tensile strength of the electrode metal per square inch.
   c. Number 1 represents flat weld, horizontal, vertical, and overhead.
   d. If the third number is 2, it can be used for flat and horizontal, but a 3 means flat only.
   e. The number 3 may mean the chemical analysis of the flux, the polarity of the electrode, AC or DC rating, or the penetrating capacity of the electrode. A # 6011 electrode will penetrate deeper than a # 6014 electrode.

6. Mild steel # E 6011 or E 6013 for an AC welder and # E 6010 for a DC welder

7. a. Heavy steel plate
   b. Cast iron
   c. Aluminum
   d. Sheet steel

8. Base metal is not welded together with the bronze metal. A strong bond is formed between the two metals.

9. a. Loses its strength when subjected to 500 degrees F.

UNIT: Introduction
TOPIC: Importance of Welding and Identification of Metals
(Answer Sheet continued)

b. Cannot be used on parts that operate at high temperatures
c. Does not fuse with the base metal

10. a. Flat
b. Vertical
c. Horizontal
d. Overhead

11. a. Single bevel butt
b. Square butt
c. T-joint
d. Double bevel butt

12. a. Cutting
b. Piercing
c. Beveling
d. Gouging

Answer Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Introduction

TOPIC: Tires and Wheel Rims

1. a. Sidewall
   b. Bead
   c. Tread
   d. Shoulder
   e. Body plies
   f. Air container

2. The tire plies are tied to a strong bundle of wire, the bead. It serves as the tire foundation by anchoring the tire to the rim.

3. a. Rayon
   b. Nylon
   c. Cotton
   d. Polyester

4. Ply cords run from one tire bead to the other at an angle. Alternate plies run in opposite directions.

5. Belted bias plies are low angle cords which surround the tire body under the tread. Belted radial plies run from bead to bead across the body at an approximate right angle to the bead. The belts are made up of cords underneath the tread.

6. a. Provide traction
   b. Resist cuts
   c. Provide long wear

7. a. Rib tread I-1
   b. Traction tread I-3
   c. Plow tail wheel I-4
   d. Smooth tread I-6

8. a. Cracks caused by stress on the sidewalls
   b. Tread wear on each side of the tire
   c. Shoulder wear caused by rim bruises
   d. Damaged valve stems
   e. Powered equipment difficult to steer
   f. Tire slippage on rim

9. a. Short turns and passing over sharp objects cause cuts.
   b. Tire fabrics tend to rot if exposed to moisture over long periods of time.
   c. Overloading and under-inflation damage sidewalls. Also sidewalls can be damaged by tire tools.

UNIT: Introduction
TOPIC: Tires and Wheel Rims
(Answer Sheet continued)

d. Low speed tires moving at high speeds will weaken the fabric and rubber.

10. a. Wide base drop center rims
    b. Double bevel drop center rims
    c. Deep well drop center rims
    d. Drop center rims for front wheels

Answer Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Introduction

TOPIC: Tubing and Hoses

1. Hoses are used mainly on the hydraulic unit on farm equipment.

2. a. Braking system
   b. Steering system
   c. Lubricating system
   d. Cooling system
   e. Cooling system
   f. Air conditioning system
   g. Instrumentation system

3. a. Transfer fluids
   b. Transfer gases
   c. Create vacuums
   d. Transfer air

4. This type of tubing is used for fuel, vacuum, and lubrication lines where high pressures and excessive heat do not exist.

5. a. Flare
   b. Compression
   c. Pipe

6. a. Connectors
   b. Elbows
   c. Unions
   d. T-fittings
   e. Bushings
   f. Plugs
   g. Nipples
   h. Distribution blocks
   i. Valves

7. a. Medium
   b. High
   c. Very High

8. a. Rubber inner lining
   b. Wire braid
   c. Fabric braid
   d. Rubber cover

Answer Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Primary Soil Tillage Equipment

TOPIC: Moldboard Plows

1. a. Stubble
   b. General purpose
   c. Breaker
   d. High-speed

2. Soil condition, topography, adjustment of the plow, the way the plow is hitched to the tractor, depth and rate of plowing, and the sharpness of the shares, colter, and jointers

3. Draft is the amount of resistance to the source of power which is created by a plow.

4. A. Trailing
      a. Regular -- one to eight bottoms
      b. Two-way -- one to four bottoms
      c. Middlebreakers -- one to four bottoms
   B. Mounted
      a. Regular -- one to five bottoms
      b. Two-way -- one to two bottoms
      c. Middlebreakers -- one to five bottoms

   C. Semi-mounted
      a. Steerable -- over five bottoms
      b. Non-steerable -- one to five bottoms

5. Vertical line of draft is a straight line from the draft center of the plow tractor drawbar while viewing the plow from the side. Horizontal line of draft is a straight line from the draft center of the plow to the tractor drawbar viewed down the plow.

6. a. Single-point hitch, free-floating, rear-mounted plow
   b. Three-point, free-floating, variable-pitch, rear-mounted plow
   c. Hydraulically-supported, three-point suspended plow
   d. Hydraulically-suspended, free-floating, three-point, variable-pitch plow

7. Depth wheels can be used to keep the point at a certain depth. The hitch point may be adjusted so that the tractor will pull upward more as the point goes deeper. Actually, the plow bottom levels off and goes no deeper when the heel of the landside or the rolling landside contacts the furrow sole.

UNIT: Primary Soil Tillage Equipment
TOPIC: Moldboard Plows
(Answer Sheet continued)

8. a. Regular-suck (3/16")
   b. Deep-suck (5/16")
   c. Double-deep suck (3/8")

VOCABULARY:

1. Land - refers to the ground or earth that has not yet been plowed
2. Landside - the part of the plow which rubs or rolls against the land furrow wall
3. Furrow - the space left in the land when the furrow slice is inverted or turned on its side
4. Colter - a round disk blade used for cutting the earth and trash just ahead of the plow bottom
5. Penetration - the ability of a plow bottom to penetrate the soil

Answer Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Primary Soil Tillage Equipment

TOPIC: Disk Plows

1. a. Direct-mounted
   b. Semi-mounted
   c. Trailing

2. a. Sticky, waxy, gumbo, non-scouring soils, and soils having a hardpan or plow roll
   b. Dry, hard ground that cannot be penetrated with a moldboard plow
   c. Rough, stony, and rooty ground where the disk will ride over the rocks
   d. Peaty and leaf-mold soils where the moldboard plow will not turn the slice
   e. Deep plowing

3. The disk plow is often heavier, which may increase the draft more than that of a moldboard plow. Also, because the disk plow is often used under more adverse conditions than the moldboard plow, its draft may be somewhat higher.

4. The 26" is the diameter of the disk. The 3/16" is the gauge (thickness) in inches of the metal disk blade.

5. a. Trailing--steers the plow
   b. Semi-mounted--pivots on a vertical axle at the rear disk
   c. Mounted-absorbs the thrusts and can move up and down

6. a. Cutting angle adjustment
      (1) Pivoting the beam
      (2) Pivoting the blade and standard
      (3) Changing the angle
   b. Width-of-cut (swath) adjustment
      (1) Front disk blade cut adjustment
      (2) Cutting width adjustment
   c. Vertical adjustment of the disk blade
      (1) Standard-to-beam method
      (2) Standard-to-bearing method

UNIT: Primary Soil Tillage Equipment
TOPIC: Disk Plows
(Answer Sheet continued)

VOCABULARY:

1. Concavity - the "disk" of the blade; measured in inches and may vary considerably
2. Standard - connects the disk bearing and the plow beam
3. Scrapers - attachments designed to clean the disk blades and cover the rod and trash more satisfactorily
4. Tilt or slant - the vertical adjustment of the plow

Answer Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Primary Soil Tillage Equipment

TOPIC: Middlebusters and Listers

1. Listers have bottoms suitable for general-purpose plowing such as stubble. The middlebuster bottom is used in areas requiring a blackland type moldboard.

2. a. Trailing
   b. Mounted

3. By the number of bottoms, such as one-, two-, or three-bottom

4. a. Bottoms
   b. Beams
   c. Footpiece
   d. Shares
   e. Runner
   f. Depth wheels
   g. Links

5. a. Flatbreaking - Plowing land by turning it over so that the field appears flat after the operation
   b. Middlebreaking - plowing land so that surface is left in ridges and furrows
   c. Busting - another name for the operation of making furrows and ridges
   d. Ridge sweeping - preparing the top of a bed for planting
   e. Hipping - a term used in the Mississippi Delta which means throwing soil on each side of a bed that is already made by a middlebreaker. It is cleaning out or reshaping the furrow

6. Front and rear mounted middlebreakers are equipped with gage wheels to regulate the depth or uniformity of plowing. Front mounted equipment can be operated in a field that is too wet for a rear mounted unit. This is due to the rear wheels operating in the middlebreaker furrows. Rear mounted equipment (middlebreakers) is easily spaced or removed when attached to a tool bar.

Answer Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Primary Soil Tillage Equipment

TOPIC: Rotary Plows

1. 1876

2. Because of high cost and large power requirements of earlier models

3. a. Pull auxiliary-engine rotary plow
   b. Tractor-mounted power-take-off-driven rotary plow
   c. Self-propelled garden-type rotary plow

4. The pull auxiliary-engine rotary plow is pulled forward by a tractor but has cutting knives driven by an auxiliary engine mounted on the frame of the plow.

5. 4', 5', and 6' sizes
   60 to 90 horsepower

6. 300 r.p.m.

7. 9 to 30 inches wide

8. Negative draft is when the rotating blades push the tractor along.

9. Energy required for rotary tillage is about 3 times as much as required for moldboard plowing.

10. 1. Shred and mix stalks with the soil
    2. Replace plow, disk, and harrow
    3. Cultivate row crops
    4. Renovate pastures
    5. Till orchards and vineyards

Answer Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Primary Soil Tillage Equipment

TOPIC: Chisel Plows and Subsoilers

1. A chisel plow is a spring-tooth type of implement designed to break up the soil as much as 18" deep without inverting or pulverizing the soil. A subsoiler breaks up the soil so water and air may penetrate.

2. In general, a smaller tractor is used with the chisel plow than with the subsoiler. Normally, it takes 5 to 75 horsepower for a chisel plow and about 25 to 100 horsepower for subsoilers.

3. a. Topsoil
   b. Hardpan
   c. Subsoil

4. a. Trailing
   b. Mounted

5. a. Chisel
   b. Spike
   c. Furrower
   d. Sweep
   e. Shovel
   f. Wheatland Sweep
   g. Twisted Shovel

6. The subsoiler consists of a beam or tool bar, perhaps an axle and wheels, a shank or standard fitted with a point, sometimes a shin, plus a few minor attachments.

7. From 12" to 3'

8. 5' to 45'

Answer Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Secondary Tillage Equipment

TOPIC: Disk Harrows

1. The disk harrow breaks up clods by means of steel disks. It mixes the soil thoroughly, bringing together vital plant food elements. It levels the land, aerates the soil, kills weeds, and prepares the ground for seeding and plowing.

2. a. Regular
    (1) Single-action
    (2) Double-action
   b. Offset

3. a. Width of cut made when fully angled
   b. Diameter of the disk blade
   c. Number of disks
   d. Disk spacing

4. a. Plain
   b. Notched

5. a. Plain disks may be regular or contour or have crimped centers.
    (1) The plain, regular disk usually has about 2" of concavity per 20" diameter.
    (2) The crimped disk has a flat center to fit flattened spaces and bearings, and it may be stronger than those having the regular contour.
   b. The notched or cutaway disk is suitable for trashy conditions. As the disk rotates, the cutout edges give a very severe slicing and cutting action.

6. a. Using a heavy or light harrow
   b. Adding weights to the harrow
   c. Using few or many disks per harrow
   d. Exerting hydraulic forces up or down
   e. Using transport and depth-regulating wheels
   f. Using dull or sharp disk blades
   g. Using smaller or larger disks
   h. Using cutout or notched disks
   i. Adjusting the angle of the disk gangs

UNIT: Secondary Tillage Equipment
TOPIC: Disk Harrows
(Answer Sheet continued)

7. a. Disk
   b. Disk gang
   c. Harrow frame
   d. Bearings
   e. Bumpers
   f. Scrapers
   g. Weight boxes

8. a. Drive ahead to straighten hitch. This is done with a slider on the drawbar tongue.
   b. Back up to straighten method. This is accomplished with the inner ends of the gang which are fastened to the slider.

VOCABULARY:

Gang - a group of two or more disks
Tandem - two sections or one trailing another
Angling - changes the gang so that it does not roll straight ahead but at an angle to the line of travel
Bush and log harrow - a heavy-duty machine for breaking up brush land and potential pasture land

Answer Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Secondary Tillage Equipment

TOPIC: Spring-Tooth Harrows

1. These harrows are used mainly to prepare seed beds.

2. a. Lift
   b. Trailing

3. a. Regular
   b. Quack grass
   c. Alfalfa
   d. Renewable-point

4. a. Teeth
   b. Tooth bar
   c. Tooth bar standards
   d. Tooth clamps
   e. Frame and shoes
   f. Hitch and draft links
   g. Gage wheels

5. Most models have either a straight or a bent lever for adjusting the depth of tooth penetration. Each section usually has one lever. The lever moves the tooth bar which, in turn, moves the teeth.

   a. Adjust the teeth so they will cut a uniform depth
   b. Adjust the hitch so the harrow runs level, with the front and back teeth cutting the same depth
   c. Operate at a steady, fairly slow speed

Answer Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Secondary Tillage Equipment

TOPIC: Spike-Tooth Harrows

1. This harrow is used as a cultivator.

2. a. Ridge
   b. Flexible

3. a. Closed square-end type
   b. Open-end
   c. Closed curved-end

4. Width: 3-1/2' to 5'
   Sections: 1-6
   Weight per section: 100 - 150 pounds

5. 9" between teeth on each of the five bars. As the harrow passes over the ground, there is a distance of 1-4/5" between the teeth.

6. Various methods are used to fasten spike-teeth to the bars to make them secure. Notched bars assist in holding the teeth in position. Collars of bars prevent loose teeth from being lost. Some are welded to the tooth bar.

7. a. Spike teeth
   b. Tooth bars
   c. Tooth clamps
   d. Frame
   e. Adjustable levers
   f. Drawbars

8. A spring-tooth harrow penetrates the soil, pulls weed roots to the surface, mixes plant residue in the soil, and prepares the seedbed for planting. The spike-tooth harrow fills in low places, smooths the soil, breaks up clods, and will cover small broadcast seed.

Answer Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Secondary Tillage Equipment

TOPIC: Land Rollers and Pulverizers

1. a. Land rollers
   b. Land packer
   c. Land pulverizer
   d. Land mulcher

2. a. Plain ridge
   b. Serrated
   c. Wavy
   d. Sprocket

3. The purpose of the tools is to crush lumps of soil and to compact the soil after plowing or harrowing to form a firm seedbed.

4. a. Wheels
   b. Rollers
   c. Sprockets
   d. Frame
   e. Bearings

5. Because of the slow speed, wood bearings are adequate in addition to being cheap and easy to replace.

6. A mulcher tends to mulch or break the soil crust so that seed can germinate and at the same time control young weeds by disturbing their root system. Packers may be considered clod crushers, soil firming, and soil packing equipment.

7. A treader packer has curved teeth to penetrate the soil when it is pulled forward. This forward movement pulverizes the soil and destroys weeds. The backward movement of the wheels causes the packer to tread plant residue into the soil.

8. A subsurface packer presses the soil together and usually leaves a mulch on top. This type of packer can be used to conserve soil moisture.

Answer Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Secondary Tillage Equipment

TOPIC: Rotary Hoes

1. The rotary shredder cuts, shatters, feathers, tears, chops, mows, pulverizes, spreads, and mulches any foreign material so that is may be returned to the soil.

2. Less tilling and more packing is accomplished when the rotary hoe is pulled backward.

3. The two types of rotary are trailing and mounted. Mounted hoes are transported and adjusted for operation by hydraulic controls. Trailing type of hoes are mounted on wheels or they are pulled free of wheel support. The wheelless trailing hoe is pulled backward to and from the field or it is hauled on a trailer.

4. Gangs are made up of seven wheels and an axle. A section consists of two gangs, and it is made according to the width of a row. For example, a section may vary from 36 to 46 inches wide.

5. Several crops that are cultivated by the rotary hoe are:

   a. Cotton
   b. Corn
   c. Peas
   d. Beans
   e. Sorghums

6. A trailing type rotary hoe should be transported by pulling it backwards.

Answer Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Planting Equipment

TOPIC: Grain Drills

1. To sow seed or grain in the correct amounts and proper depth and to cover the seed and firm the soil

2. a. End-wheel type
   (1) Fluted force-feed
   (2) Double-run feed
   b. Trailing press wheel
   c. Fertilizer drill

3. a. Width in feet of the entire drill
   b. Number of furrow openers
   c. Spacing between runs

4. a. Width in feet of the entire drill: 9' to 15'
   b. Number of furrow openers: 5 to 24
   c. Spacing between the runs: 6" to 16"

5. a. Select the side of the feed wheel recommended on the drill charts.
   b. Change the speed of the wheels by changing gears or sprocket or both.
   c. Change the position of the feed gate in cup.
   d. Use reducers below the feed wheel.

6. a. Moving the fluted roll endways
   b. Adjusting the gates or latches to one of three positions
   c. Changing the speed of the feed shaft

7. a. Sliding furrow openers
   b. Hoe or horn furrow opener
   c. Shoe or runner opener
   d. Rolling furrow openers

8. a. Feeding devices
   b. Furrow openers
   c. Dragbars
   d. Seed coverers
   e. Frame
   f. Wheels
   g. Axles
   h. Hoppers
   i. Fertilizer devices
   j. Grass-seeding attachment

UNIT: Planting Equipment
TOPIC: Grain Drills
(Answer Sheet continued)

VOCABULARY:

Run - the opening or hole through which the seed passes to the furrow opener
Spacing - the distance between each run, given in inches

Answer Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Planting Equipment

TOPIC: Row-Crop Planters

1. a. Regular drill planters
   b. Checkrow planters

2. a. Rear-mounted
   b. Front-mounted

3. a. Single-seed cotton hopper
   b. Richmond
   c. Reverse-feed cotton hopper
   d. Duplex hopper

4. a. Full hill drop plate
   b. Single cell plates
   c. Edge drop plates

5. a. Soil tilth
   b. Soil moisture
   c. Kind of seed
   d. Local practice

6. a. Bed planting - seeds planted on beds formed by planter attachments
   b. Water furrow planting - in trenches made by lister planter attachments
   c. Flat planting - on previously prepared "flat" ground
   d. Blackland planting - in beds previously made by the middlebusters

7. a. Hoppers
   b. Planter-drive mechanism
   c. Furrow openers
   d. Furrow coverers
   e. Driving devices
   f. Wheels
   g. Axles
   h. Frame
   i. Markers
   j. Power lifts
   k. Planter hitches

8. a. Variable-depth opener
   b. Constant-depth opener

9. a. Curved runner
   b. Fully curved runner
   c. Stub runner
   d. Shovel opener
   e. Single-disk opener
   f. Curved double-disk opener
   g. Coulter double-disk opener

10. a. Open-center press wheel
    b. Disk coverers
    c. Blade coverers
    d. Rubber-tired press wheels
    e. Zero-pressure rubber tires
    f. Shovels
    g. Knife blade

Answer Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Cultivating and Weed Control Equipment

TOPIC: Introduction

1. a. Cultivation by stirring the soil
   b. The use of flame for weed control
   c. The use of chemicals for weed control

2. Weeds rob the farmer by:
   a. Reducing yields
   b. Harboring insects
   c. Lowering the quality of the crop
   d. Reducing land value
   e. Destroying crops

3. The first cultivator was introduced in 1837. A sulky cultivator came into being in 1878. In 1905 a one-horse walking type with two plow bottoms was developed. The year 1923 a tractor type cultivator was introduced to the American farm.

4. Cultivation is practiced before and after planting for the same reasons: to control weeds, mulch the soil, retain moisture, aerate the soil, and promote the growth of microorganisms.

Answer Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Cultivating and Weed Control Equipment

TOPIC: Cultivators

1. a. Row-crop cultivators--mounted (front and rear) and trailing
   b. Field cultivators--mounted (rear) and trailing

2. a. To retain moisture by killing weeds which use water, loose mulching on surface to reduce evaporation, and retaining rainfall or irrigation water
   b. To aerate the soil to allow oxygen to penetrate
   c. To promote activity of microorganisms

3. a. Ground-engaging equipment (sweeps, shovels, spikes, disks, knives and hoes, and furrow)
   b. Standards
   c. Frame

4. a. Blackland
   b. Mixed-land

5. a. Blackland
   b. Mixed-land
   c. Planter sweeps
   d. Duckfoot sweeps

6. a. Stems
   b. Crowns
   c. Points
   d. Wings

7. a. Spear point
   b. Irrigation shovel
   c. Arrow head
   d. Chisel-tooth
   e. Turn shovel

8. Standards connect the points with the frame of your cultivator.

UNIT: Cultivating and Weed Control Equipment
TOPIC: Cultivators
(Answer Sheet continued)

9. a. Side-mounted front gangs
   b. Rear-mounted tool bar
   c. Rear-mounted frame
   d. Trailing frames or carriers

10. A cultivator is operated in the following manner for best results: cultivate when the weeds and grasses are small, cultivate on dry and hot days if possible, cultivate at relatively high speed (about 5 miles per hour), and begin operation on matching rows.

Answer Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Cultivating and Weed Control Equipment

TOPIC: Flame Weeders

1. a. Fuel tank
   b. Feed lines
   c. Control valves
   d. Burners

2. a. Four burners
   b. Eight burners

3. 30 degrees to 45 degrees

4. 2 inches

5. 8" to 10"

6. Butane or propane

7. 30 to 40 pounds

Answer Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Cultivating and Weed Control Equipment

TOPIC: Rotary Shredders

1. a. Trailing
   b. Mounted

2. The rotary shredder cuts, shatters, feathers, tears, chops, mows, pulverizes, spreads, and mulches any foreign material so that it may be returned to the soil.

3. Width - 5' to 20'
   Weight - 250 to 3200 pounds
   Size tractor - 1-1/2 to 3 plow tractor or approximately 10 to 60 horsepower

4. a. Vertical
   b. Horizontal

5. a. Chains and hammers
   b. Blades
   c. Rubber flails

6. Cutting and chopping is accomplished by revolving knives that rotate at a high speed. The propeller-like knives or blades are attached to a spindle hub. This type of cutter operates on a horizontal plane. The machine may be equipped with one or two knives. The blades or knives receive their power from the power take-off. This power is transmitted to a gear box. Some machines that operate vertically are equipped with flails, hammers, or knives that do the cutting.

7. The major parts of a rotary shredder are: driving mechanism, frame and cover, blades, gear box, and wheels. On vertical mowers, the flail or knife cylinder is a major part.

Answer Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Sprayers and Dusters

TOPIC: Hydraulic Sprayers

1. a. Pump
   b. Tank containing an agitator
   c. Framework
   d. Pressure gauge
   e. Strainers
   f. Combined pressure regulator and unloader or relief valve
   g. Screen
   h. Control valves
   i. Piping and fittings
   j. Distributing system
   k. Power source

2. a. Reciprocating (piston, plunger)
   b. Rotary
   c. Diaphragm

3. a. Hollow cone
   b. Solid cone
   c. Flat-fan

4. a. Type of spray job
   b. Row spacing and number of nozzles used per row
   c. Approximate speed of travel
   d. Amount of spray to be applied per acre
   e. Nozzle spacing if complete coverage is desired
   f. Spray pattern desired
   g. Approximate pressure to be used in spraying

5. See Information Sheet, page 4.

6. a. Fan type
   b. Hollow-cone type
   c. Solid-cone type

7. Liquid spray passes from the pump into a hose and pipe. The end is plugged, forcing the liquid through the many holes. This action keeps the material in suspension, but it is not as effective as a mechanical agitator.

Answer Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Sprayers and Dusters

TOPIC: Pumps for Agriculture Sprayers

1. a. Piston
   b. Gear
   c. Roller impeller
   d. Diaphragm
   e. Internal gear
   f. Centrifugal

2. a. Gear
   b. Centrifugal
   c. Roller impeller
   d. Internal gear
   e. Diaphragm
   f. Piston

3. a. Piston - wide range of application; will handle corrosive and abrasive materials
   b. Gear - oil emulsion, non-abrasive materials; cannot be used with wettable powders
   c. Roller impeller - oil emulsions and non-abrasive materials; no copper compounds; rubber rollers for slurries and wettable powders
   d. Diaphragm - will handle all chemicals which will not attack diaphragm
   e. Internal gear - will not handle abrasives
   f. Centrifugal - will handle coarse and abrasive materials

4. See pictures on Information Sheet.

5. Pumping is caused by the rollers following the eccentric housing. Rollers are forced out of the impeller slots to the pump housing by centrifugal force. Liquid is displaced or forced out under pressure as the rollers approach the outlet port. Liquid is drawn into the intake port by the creation of a vacuum as the rollers move from the impeller.

6. The diaphragm pump can develop pressure up to about 100 pounds per square inch. It is considered a low pressure pump. This type of pump can handle abrasive and coarse chemical materials.

Answer Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Sprayers and Dusters

TOPIC: Blower Sprayers

1. Large acreages of fruit trees, large shade trees, and vegetables

2. A large blast of air

3. A low-pressure, low-volume pump ranging from 1 to 8 gallons per minute and 50 to 400 pounds pressure

4. Because the spray is 20% to 80% more concentrated than in other types of sprayers, which makes it extremely important that the proper amount of chemical be applied

5. If the sprayer moves too fast, under-dosing will occur and if it moves too slow over-dosing is likely to take place. Under-dosing will likely cause a waste in time and money due to an improper amount of chemical being applied to the plant. An over-dose of spray may cause plant damage.

6. Spray material is applied in fine droplets, which are carried by the air to specific areas. The residual action of this spray method is usually small; therefore, the airborne chemical contacts the insect or pest.

Answer Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Sprayers and Dusters

TOPIC: Dusters

1. a. Hopper
   b. Agitator
   c. Blower
   d. Duct
   e. Spout delivery system

2. a. Field duster
   b. Orchard power duster

3. (Applied to community)

4. Advantages of dusters over sprayers are:
   a. Simpler
   b. Lighter
   c. Cheaper in initial cost
   d. Less corrosion

5. a. Spray can be applied in winds up to 10 miles per hour where dust cannot be applied in winds over 3 miles per hour.
   b. Sprays can be applied during a longer period of time during the day.
   c. The size of the droplets can be changed to fit the conditions of application and the problem.
   d. Drift hazards are less.
   e. Sprays are usually cheaper.
   f. Sprayers usually get better control.
   g. A higher rate of deposit of the toxicant is obtained with sprays.
   h. Flagmen are more essential with sprays, which usually results in a better application.

6. Mist sprayers are used mainly to spray trees. It is called a fog sprayer because the mist is usually placed where it will drift with the wind. An orchard mist sprayer has several nozzles fixed in a pipe manifold. An air stream is forced through the manifold by a powerful fan forcing the material out to tree tops.

Answer Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Sprayers and Dusters

TOPIC: Calibrating Spray Equipment

1. $$\text{mph} = \frac{495 \times 0.050}{1.25 \times 4} = \frac{24.75}{5} = 4.95 \text{ mph}$$

2. $$\text{gpa} = \frac{495 \times 0.055}{1 \times 5} = \frac{27.225}{5} = 5.445 \text{ gpa}$$

3. $$\text{gpm} = \frac{25 \times 7 \times 15}{5940} = \frac{2625}{4950} = .44 \text{ gpm}$$

4. $$\text{Length of boom} = \frac{43560 \times 70}{.75 \times 8 \times 5280 \times 6} = \frac{3049200}{19080} = 16.04'$$

5. $$\text{Pump output in gpm} = \frac{5280 \times 4 \times 20 \times 8}{60 \times 43560} = \frac{3379200}{2613600} = 1.3 \text{ gpm}$$

Answer Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Fertilizers

TOPIC: Manure Spreaders

1. a. Driven by tractor power take-off
   b. Driven by spreader wheels

2. a. Frame
   b. Conveyor
   c. Box
   d. Beater
   e. Widespread

3. a. Number of animals
   b. Hauling distance to fields
   c. Hilly conditions
   d. Traction
   e. Softness of the soil

4. a. Regular-pitch roller chain
   b. Double-pitch roller chain
   c. Pintle chain
   d. Detachable link chain

5. Manure spreader boxes are rated in bushels; sizes range from 45-175 bushels.

6. The conveyor, also called the apron, conveys the manure to the rear of the spreader. The conveyor mechanism consists of chains, slats, axles, and sprockets.

7. Nearly all boxes are 1" to 2" wider at the rear than at the front. This prevents packing the manure as it is forced to the rear by the conveyor.

Answer Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Fertilizers

TOPIC: Dry Fertilizer Distributors

1. a. Those having their own wheels
   b. Those mounted on tractors

2. a. Agitators and rotors
   b. Shutters
   c. Levers
   d. Hoppers
   e. Frame
   f. Clutches
   g. Wheels and axles
   h. Drawbar

3. The size is determined by the width of the hopper or box (width it will sow), which is usually 8' to 12'.

4. a. Vertical side and one sloping side
   b. Both sides sloping

5. A rotor is a device that forces the material through the parts; an agitator is a separate upper rod for agitating the material and keeping it from bridging in the hopper.

6. a. Use a whisk broom, a stiff brush, an air hose, or even a water hose to thoroughly clean the hopper and all moving parts.
   b. Scrub until absolutely no specks of fertilizer remain.
   c. After thoroughly cleaning the machine, brush or spray the distributor hopper with a 50-50 mixture of used crankcase oil and kerosene or fuel oil. This prevents rust or corrosion.
   d. Use rust preventive when storing or putting the machine away for the season. It will last much longer than oil or kerosene.

Answer Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Fertilizers

TOPIC: Liquid and Gas Fertilizer Equipment

1. a. Anhydrous ammonia
   b. Aqua ammonia
   c. Complete neutral solution
   d. Ammonium phosphate (neutral)
   e. Nitrogen solution (non-pressure)
   f. Nitrogen solution (low-pressure)
   g. Phosphoric acid

2. a. 300-pound pressure gauge
   b. Liquid outlet valve screwed directly into the shell of the tank and connected to a pipe extending down inside the tank to within 1/2" to 3/4" of the bottom. The bottom end of the pipe should have a 1/64" mesh strainer.
   c. Safety or pop-off valve of 3/4" to 1" set for 250 pounds per square inch pressure
   d. A 3/4" or 1" automatic back-seating, liquid-filling valve
   e. A liquid-level gauge
   f. Vapor return valves, 1/2" to 3/4", with a short pipe extending into the tank to prevent filling to over 85% water capacity; also used for gas escape in bleeding

3. The metering device regulates the flow of anhydrous ammonia to the desired rate per acre.

4. $\frac{7 \times 3600 \times 4 \times 3.5 \times 40}{43560 \times 0.82} = \frac{14122000}{35719.2} = 39.2$ gallons

Answer Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Combines

TOPIC: Introduction

1. a. Self-Propelled - a self-propelled combine is considered a complete harvesting unit. Its complete operation is from a built-in engine.
   b. Tractor-Drawn - there are two types of tractor drawn combines.
      (1) Combine driven by tractor PTO
      (2) Combine driven by its engine

2. a. Pull type (power take-off or auxilliary engine supplying cutting and threshing power)
   b. Self-propelled

3. a. Cutting the standing grain
   b. Feeding the cut grain to the cylinder
   c. Threshing the grain from the stalk or stem
   d. Separating the grain from the straw
   e. Cleaning the grain by removing chaff and other foreign matter
   f. Grain handling from combine to tank and from tank to truck

4. Two steps of progress led to the modern combine: the development of implements for reaping and implements for threshing.

5. Combine sizes are expressed by the width of swath the combine can cut. Smaller sizes cut a 5' swath and larger sizes as much as a 20' swath.

6. a. Cutting unit, header
   b. Feeding unit
   c. Threshing unit
   d. Separating unit
   e. Cleaning unit
   f. Grain-handling unit

Answer Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Combines

TOPIC: Cutting, Feeding, and Threshing Mechanisms

1. a. Reel - holds the grain against the knife while the stalks are cut, then delivers the cut grain to the feeding mechanism
   b. Dividers - separate the standing grain and define the swath to be cut
   c. Cutting bar - along with its reciprocating knife (sickle) actually cut the head of grain from the stem

2. Platform - holds the cutter bar and feeding mechanism
   Feeding auger - moves the cut grain to the center of the platform where auger fingers feed the grain into the feeder conveyor or the feeder beater, depending upon the design of the combine
   Feeder conveyor or feeder beater - feeds the grain steadily and evenly into the threshing unit

3. a. Cylinder - The cylinder will have either bars or spikes that will cause the rubbing of the grain against the concave.
   b. Concave - The concave is the stationary part that the cylinder works against the threshing action.
   c. Cylinder beater - The beater behind the cylinder slows down the material coming from the cylinder, tears apart the straw, and delivers the material to the straw rack or the straw walker, as it may be called. The beater helps in cleaning the straw from the cylinder, preventing cylinder wrapping and feedback.
   d. Feeding plate - The feeder plate is an adjustable plate located where the cut grain is fed into the cylinder concave unit.
   e. Cylinder stripper - The cylinder stripper is set parallel to and above the cylinder and prevents back feeding.

Answer Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Combines
TOPIC: Separating and Cleaning Mechanisms

1. a. Straw rack - shakes loose grain out on to the grain return pan and dispenses the straw out the rear of the machine
   b. Grain return pan - catches the grain as it falls through the rack and moves forward to the grain pan
   c. Grain return conveyor - may be used instead of a grain return pan to catch the grain and move it forward
   d. Grain pan or grain conveyor - catches the grain from the concave and cylinder grates and from the return pan or conveyor for delivery to the cleaning unit. Some combines will use a conveyor in place of the grain pan to collect and deliver grain to the cleaning unit.
   e. Check flaps or curtains - deflect the straw and grain onto the rack as the full length of the rack is used for separation

2. a. Adjustable chaffer - acts as a sieve; made up of a series of cross pieces mounted on rods and fastened together so they can be moved at the same time to adjust the size of the openings
   b. Sieve - similar to the chaffer, except the lips and openings of the sieve are smaller; does the final job of cleaning
   c. Cleaning fan - furnishes a blast of air; primary function is to keep the material "alive" on the chaffer and sieve
   d. Clean grain auger and clean grain elevator - auger collects the cleaned grain and augers it to the clean grain elevator which delivers the clean grain to the grain tank
   e. Tailings auger and tailings elevator - tailings auger collects all of the material which comes off the lower sieve plus any material which falls through the extension chaffer; tailings elevator returns the "tailings" to the cylinder for rethreshing
   f. Tailboard - keeps the unthreshed material from being carried out of the combine while still allowing the chaff to be blown out

Answer Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Combines

TOPIC: Grain Handling Unit and Combine Attachments

1. a. Clean grain auger
   b. Clean grain elevator
   c. Grain tank and tank unloader
   d. Bagger and bag chute

2. a. Clean grain auger - collects the grain at the bottom of the shoe and conveys it across the combine to the elevator
   b. Clean grain elevator - elevates grain from the auger and discharges it into the grain tank or bagger
   c. Grain tank - retains the grain until a truckload or wagonload has accumulated
   d. Tank unloader - augers the grain from the tank into the wagon or truck
   e. Bagger and bag chute - sacks the grain with a two-spout bagger attachment replacing the grain tank; one bag is filled while the other is being removed, tied, or sewed. A platform is provided for the operator, and there is a chute down which he slides the full sacks to the ground.

3. a. Straw spreader
   b. Straw windrower
   c. Straw loader
   d. Straw chopper
   e. Windrow pickup
   f. Windrow spreader
   g. Bundle-topping vertical cutter bar
   h. Flax roller
   j. Bagger
   j. Grain bin
   k. Cylinder-speed tachometer
   l. Scourkleen
   m. Corn harvester

4. a. Grain is unevenly ripened
   b. Fields are weedy
   c. Straw is green but crop is ripe
   d. Grain is high in moisture
   e. Crop conditions are such the legume crops tend to shatter if left until ripe
   f. Weather conditions delay direct combining

5. The combine can be converted from small grain to shelled corn harvesting by exchanging the small grain cutting and feeding unit for the corn head attachment. The corn head snaps the ears from the stalks and feeds them into the cylinder for shelling. The rubbing action of the rotating cylinder shells the corn.

Answer Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Corn Pickers

TOPIC: Introduction

1. a. Corn snapper
   b. Corn picker
   c. Corn picker-sheller

2. a. Corn snapper - the simplest machine; only snaps the ears from the stalk and does not remove the husks from around the ears
   b. Corn picker - snaps the ears from the stalk and removes husks from the ears
   c. Corn picker-sheller - a fairly new machine that performs both the snapping and husking activities and shells the corn

3. a. Pull-type - tractor-drawn and driven by the power take-off
   b. Mounted-tractor - mounted and driven by the power take-off
   c. Self-propelled - driven by its own source of power

4. Capacity is expressed by the number of rows for which a certain model is designed, such as one-row or two-row.

5. a. 6 to 8 acres per day
   b. 8 to 10 acres per day
   c. 20 acres per day
   d. 20 to 30 acres per day

6. a. One-row corn snapper: one- or two-plow tractor
   b. One-row corn picker: two-plow tractor
   c. Two-row corn picker: two-or three-plow tractor

7. a. Gathering
   b. Snapping
   c. Husking
   d. Cleaning
   e. Shelling

Answer Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Corn Pickers

TOPIC: Gathering and Snapping Mechanisms

1. a. Points
   b. Gathering chains
   c. Dividers

2. a. Points - direct the stalks into the throat of the gathering mechanism
   b. Gathering chains - pull the stalks into the snapping rolls
   c. Dividers - divide the two rows; in some models the center divider is steered with the tractor steering wheel.

3. Sketch - Farm Machinery and Equipment, p. 348 or Information Sheet, Gathering and Snapping Mechanisms.

4. Snapping rolls consisting of:
   a. Shield
   b. Lower bearing
   c. Outer roll
   d. Live points
   e. Bearing housing
   f. Inner roll
   g. Linkage

5. The snapping mechanism removes the corn ears from the corn stalk. This function is performed by two long, closely-spaced rolls. The rolls slant upward and turn toward each other at a high speed. The snapping rolls are equipped with spiral lugs which grip onto the corn stalks and pull them down through the rolls. As the stalks are pulled down through the snapping rolls, the corn ear is pinched off the stalk and conveyed onto the husking rolls.

Answer Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Corn Pickers

TOPIC: Husking, Cleaning, and Shelling Mechanisms

1. a. Continuous or combination rolls
   b. Separate husking rolls

2. The continuous or combination rolls are a continuation of the snapping rolls; the separate husking rolls have a separate drive and are independent of the snapping rolls.

3. The husking rolls operate in pairs. One roll is usually rubber or rubber-coated and the rolls rotate toward each other, similar to the action of the snapping rolls. The rolls are corrugated, allowing them to grasp and pull the husks from the ear. The corn ears are held against the husking rolls with a minimum of shelling of kernels from the cob.

4. a. Ejecting rolls
   b. Augers
   c. Fan

5. a. Ejecting rolls - remove trash and husks from the husking rolls
   b. Augers - dispose of the trash and husks
   c. Fan - delivers the blast of air to blow off loose husks, leaves, pieces of stalks, and other trash

6. Cleaning is accomplished by a mechanical trash ejector and by air blasts. Ejecting rolls and augers remove trash and husks from the husking rolls and discharge it to the ground. The air blast from the fan strikes the ears as they leave the husking rolls. The strength of the air blast can be adjusted as needed to blow off loose husks, leaves, pieces of stalk, and other trash.

7. a. Peg-studded cylinder
   b. Cylinder screen
   c. Agitating sieves
   d. Fan
   e. Auger

UNIT: Corn Pickers
TOPIC: Husking, Cleaning, and Shelling Mechanisms
(Answer Sheet continued)

8. The shelling mechanism consists of a peg-studded cylinder that rotates inside a cylinder screen. The shelled corn drops through the holes in the screen onto a set of sieves that agitate. The trash that comes through the cylinder screen is blown away by a blast of air created by a fan located below the cylinder. The shelled corn falls through the sieves into the auger, where it is augered into the wagon.

9. a. Hopper and corn belt
   b. Cylinder
   c. Concave
   d. Cob and husk rack
   e. Return pan
   f. Fan
   g. Deflectors
   h. Sieve
   i. Cross auger

Answer Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Cotton Strippers and Pickers

TOPIC: Strippers

1. Cotton strippers are tractor-driven and are either mounted or trailing. Size range is one-or two-row machines.

2. Strippers are designed to harvest stormproof or semi-stormproof varieties. The plants are usually less than 30" tall. Because stripping is a once-over operation, harvesting is usually delayed until nearly all the bolls are open.

3. a. Roll stripper
   b. Finger stripper

4. The roll stripper employs one or more revolving rolls to strip the cotton stalk. The material used in the rolls may be steel, fabric, rubber, or bristle brushes. Steel rolls are most common.

5. a. Gathering mechanism
   b. Cleaning and conveying mechanism

6. a. The gathering mechanism lifts and guides the cotton plants into the stripper. Either a finger, roll-type, or brush stripping unit (depending upon the type of machine) strips the cotton bolls from the plant.
   b. The cleaning and conveying mechanism cleans and conveys the cotton. Cleaning is done while the stripped material is being conveyed from the stripping unit to the wagon or carrying basket. Cleaning is done either with open grills or grates or fans, depending upon the design. Rubber flights, attached to a heavy rubber belt, carry the cotton to the trailer behind the tractor. Dirt, dust, and loose trash fall through the screened bottom of the side conveyors as well as the center-delivery cross conveyor and drop on the ground. This results in cleaner cotton in the trailer and lower ginning cost.

7. Safety clutches protect the main drives of the stripper. The clutch is set to pull a full load without slipping. When the machine becomes overloaded the clutch slips.

8. Spring loaded stripper bar adjusts automatically to heavy or light cotton stalks. The steel stripping roll strips the bolls from the stalk and delivers them into the conveyors. On some machines the stripper bar can be adjusted to light or heavy cotton.

UNIT: Cotton Strippers and Pickers
TOPIC: Strippers
(Answer Sheet continued)

9. Cotton stalks are held against the roll by the stripper bar.

10. Stripper rolls perform a better job of stripping if they can be adjusted to moisture conditions, thickness of stems, and volume of plants.

11. The stalk roll is recommended when the stripper is used in tall, rank cotton. The roll is used where the plants are not firmly rooted or dead.

12. On strippers that are equipped with gauge wheels or gauge rods, the strip bar cross rod is not used.

Answer Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Cotton Strippers and Pickers

TOPIC: Pickers

1. a. Method of mounting
   b. Number of rows harvested
   c. Height of picking drums
   d. Type of spindle used

2. a. Tractor attachment
   b. Self-propelled unit

3. One or two

4. a. 20 row
   b. 14 row

5. a. Tapered-tooth
   b. Straight-tooth

6. a. Gathering Unit - Stalk lifters, spring fingers, and grid bars move cotton stalks into the picking area.
   b. Picking Unit - In the picking unit there are hundreds of spindles carried on spindle bars. Spindles rotate at 90 degrees to the direction of travel as they remove seed cotton from the stalk. A typical machine will have twenty spindles on each vertical bar. The bars are mounted on two drums (one on each side of the row). Spindles rotate and entangle and extract seed cotton from the open boll.
   c. Doffer and Spindle Unit - Doffers remove the cotton from tapered spindles after they leave the plant. The stationary rubber face doffers drop the seed cotton so that it can be picked up by air from the conveyor. Cotton from straight spindles is removed by stripper bars as the spindle passes the bar. Doffers do not clean the spindles of dirt, plant sap, and other materials; therefore, the picking unit is equipped with moisture carrying tubes that deliver the water to rubber cleaning pads which clean the spindles.
   d. Conveyor Unit - Cotton is conveyed to the carrying baskets by a fan that draws cotton from the drum through conveyor pipes. Dirt and trash are extracted from the cotton through grates by the air blast before it reaches the carrying baskets.

Answer Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Hay and Forage Equipment

TOPIC: Mowers

1. a. Trail-behind
   b. Integral rear-mounted
   c. Side- or center-mounted

2. a. Frame
   b. Cutter bar assembly
   c. Mower drives

3. The frame supports the drive and cutter bar mechanism.

4. a. Knife
   b. Knife bar
   c. Sections
   d. Guards
   e. Knife clips
   f. Outer shoe
   g. Inner shoe
   h. Knife head
   i. Wear plates
   j. Ledger plate

5. a. Pitman
   b. Wrist pin or crankpin
   c. Pitman box
   d. Flywheel
   e. Pulley

6. Most of the cutter bar type of mowers are mounted on the tractor. These types of mowers are either mounted at the rear of the tractor or just ahead of the rear wheels. Integral rear mounted mowers receive power by V-belt from the power take-off. The cutter bar is lowered and raised hydraulically. If the cutter bar is mounted on the side (between rear and front wheels) it is either powered by the PTO, V-belt, or hydraulic power from the tractor.

   Trailing draw bar type of mowers are mounted on a single set of wheels and pulled behind the tractor. Power for the knife drive is transmitted by a V-belt, chain, or gear from the PTO.

VOCABULARY:
   a. Dragbar - a heavy, solid bar which extends from the frame to the yoke
   b. Yoke - the casting to which the cutter bar is hinged
   c. Knife head - the round ball or pin to which the pitman is attached

UNIT: Hay and Forage Equipment
TOPIC: Mowers
(Answer Sheet continued)

d. Knife bar - a five- to nine-foot length of cold-rolled steel with rivet holes drilled in it for riveting to the sections
e. Sections - triangular in shape with 60 degree corners; form the upper shearing action
f. Guard - helps hold the forage during cutting and also protects the sections
g. Ledger plate - riveted to the guard; forms the lower shearing action
h. Wear plate - keeps the section tips down on the ledger plates
i. Pitman - a rigid connecting link between a crankpin on a flywheel and a reciprocating knife
j. Swath or grass board - pulls the hay to one side so the tractor wheel will have a clear path

Answer Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Hay and Forage Equipment

TOPIC: Hay Rakes

1. a. Side-delivery
   b. Dump
   c. Sweep

2. a. Cylindrical-reel
   b. Parallel-bar
   c. Side-stroke
   d. Finger-wheel

3. The function of the side-delivery rake is to lift the hay from the swath and place it in a loose, fluffy windrow with the green leaves inside, protected from the sun's rays.

4. a. Reel assembly
   b. Frame
   c. Drive mechanism

5. a. Shaft
   b. Bar
   c. Teeth
   d. Spiders
   e. Bearings
   f. Special bar-rotating devices

6. a. The rake ends can be adjusted up or down.
   b. The basket can be changed in relation to the rake frame.
   c. Vertical adjustment of the reel axle shaft may be made at each end of the basket.
   d. The basket and reel may be free to float up and down together.
   e. The height of the reel and basket may be adjusted with bolts or with the rear caster wheels.

7. a. Tractor power take-off
   b. Traction drive

Answer Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Hay and Forage Equipment

TOPIC: Hay Conditioners

1. a. Crushing
   b. Crimping
   c. Flailing

2. a. Speeds field curing; conditioning can reduce drying time by about 30%
   b. Reduces weather damage
   c. Reduces field losses due to shattering because curing time and the amount of turning and tedding are reduced
   d. Conserves color and feed value through shorter exposure and less shattering

3. a. Smooth roll
   b. Corrugated roll or crimper
   c. Flail-type forage harvester

4. a. The smooth-roll type may use two rubber rolls or a combination of a rubber roll and a steel roll. The smooth rolls give a continuous crushing action to the hay, leaving no part uncrushed. Most rubber rolls have special grooves to aid in picking up the hay and feeding it between the rolls.
   b. The corrugated-roll or crimper-type conditioner may be equipped with two malleable-iron rolls with tapered flutes that mesh together similar to gear teeth, or with slatted bar rolls. Some models use a fluted or bar roll that presses against a smooth rubber roll. As the hay presses between the rolls, it is bent, crimped, and cracked at intervals, but not completely crushed.
   c. The flail-type conditioner is really a hay harvester, but when used as a hay conditioner, the shear bar is removed to reduce the cutting action. The hay is partially chopped by the swinging hammers or knives.

5. A hay conditioner may have the following major parts: frame, PTO drive, shield, cross drive wheels, rollers, drive mechanism, height adjustments, and equipment wheels.

Answer Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Hay and Forage Equipment

TOPIC: Windrowers

1. a. Trailing
   b. Self-propelled

2. a. Cuts
   b. Windrows
   c. Conditions

3. a. Mower
   b. Conditioner
   c. Rake

4. a. Cutter bar
   b. Reel

5. a. Auger
   b. Canvas

Answer Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Hay Harvesters

TOPIC: Balers

1. a. Stationary
   b. Windrow pickup

2. a. Wire
   b. Twine

3. a. Tractor power take-off
   b. Air-cooled engine

4. Most manufacturers rate their machines by bales per minute or tons per hour. The number of tons per hour may not be a satisfactory figure. If the hay is damp, the tons per hour will be greater because each bale weighs more.

5. a. Self-tying balers making rectangular bales
   b. Balers making round bales

6. a. The area necessary to store it
   b. The width of the machine when on the highway

7. a. Pickup
   b. Feeding
   c. Compressing
   d. Tying

8. The usual type of pickup mechanism on a baler consists of a drum or cylinder with spring steel teeth. The cylinder rotates in the opposite direction of the motor of the baler, lifting the hay and moving it into the machine.

9. a. Auger and packer fingers
   b. Spring teeth and feeder arms
   c. Auger and feeder head
   d. Carrier-roller feed

10. a. Plunger
    b. Bale chamber
    c. Tension bars or rails
    d. Retaining plates

UNIT: Hay Harvesters
TOPIC: Balers
(Answer Sheet continued)

11. a. Needle brings lower wire around end of bale.
    b. Needle places wire under wire in twister pinion.
    c. Twister pinion revolves four times, twisting both wires securely.
    d. Kinker shaft and cutoff shaft turn to outside; kinker shaft kinks knot on bale; cutoff shaft cuts, twists, and kinks knot for next bale.
    e. Shafts return to neutral position; needles move downward, drawing wire into position for next bale.

12. a. Frame
    b. Wheels
    c. Tongue

13. a. Feeding too fast; irregular feeding
    b. Making bales too heavy
    c. Loose shear bolt nuts
    d. Needles not timed properly
    f. Extremely dull knives
    g. Excessive clearance between knives
    h. Improperly adjusted or worn needle brake

14. a. Slow down so feeding rate is not less than 12 strokes per 36" bale; feed uniformly.
    b. Loosen bale tension.
    c. Tighten nuts securely; always use a lock nut.
    d. Time tying mechanism.
    e. Adjust safety latch.
    f. Sharpen or replace knives.
    h. Adjust plunger - knife clearance.
    h. Apply more tension or replace linings.

Answer Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Hay and Forage Equipment

TOPIC: Forage Harvesters

1. The primary purpose of the forage harvester is to chop field crops and place the chopped crop in a wagon.

2. a. Field chopper
   b. Flail chopper

3. a. Tractor-drawn
   b. Tractor-mounted
   c. Self-propelled

4. a. Wheels
   b. Axle
   c. Frame
   d. Cutter head
   e. Blower
   f. Feeding mechanism

5. a. Cutting and feeding
   b. Chopping
   c. Blowing

6. a. Windrow pickup attachment
   b. Cutter-bar attachment
   c. Row-crop attachment

7. a. Flywheel
   b. Cylinder

Answer Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Special Equipment

TOPIC: Farm Elevators

1. a. Portable
   b. Stationary

2. a. Chain drag-flight
   b. Auger
   c. Blower

3. The chain drag-flight type elevator is available in lengths ranging from 16' to 50'. The trough may be narrow and V-shaped and use a single chain, or it may be as wide as 20" with a chain on each side of the chute to support each end of the drag flights.

4. a. Trapezoidal-shaped
   b. Rectangular-folding

5. a. Small electric motors
   b. Gasoline engines
   c. Tractor power take-off

Answer Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Special Equipment

TOPIC: Feed Mills

1. All types of feed

2. a. Tractor
   b. Electric motor

3. a. Feed collector
   b. Feed table
   c. Valve
   d. Sacking spout
   e. Suction elbow
   f. Housing
   g. Adjustable feed gate
   h. Feed collector support
   i. Blow pipe
   j. Feed collector air valve

4. a. Select the proper screen, place it in the screen groove, and lock it in position. Make sure that the screen and screen lock are seated properly.
   b. Set the air suction control so that the proper amount of air is drawn through the screen for efficient grinding.

5. a. Special attention should be given to proper adjustment of all bearings since the hammer mill turns at a high speed.
   b. All hammers must be sharpened, reversed, or replaced at the same time to insure freedom from vibration which would damage the bearings and shorten the life of the entire mill.
   c. In reassembling, particular care must be used to make certain that all cast-iron spacing collars are replaced in their original order.
   d. When replacing a broken hammer, it is well to replace the corresponding hammers in the other banks to insure proper balance, because any small difference in weight will result in vibration.

Answer Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Special Equipment

TOPIC: Feed Grinder - Mixers

1. A feed grinder - mixer is a machine that grinds the feed, usually grain, and conveys the ground feed to the hopper of a mixing tank where it is mixed with other grain or feeding materials.

2. a. Reduces the handling of feed
   b. Feed can be distributed in different locations from the mixer.
   c. Reduces cost of storing
   d. Saves time
   e. Prevents spread of diseases

3. a. Chassis
   b. Hammer mill
   c. Mixing tank
   d. Drive, conveyor, loading, and unloading mechanisms

4. a. Shovel and hammer mill
   b. Mobile feed mixer
   c. Commercial feed mill

5. a. Fine
   b. Medium
   c. Coarse

6. Screens with different mesh sizes

Answer Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Special Equipment

TOPIC: Post-Hole Diggers

1-4. Questions should be developed from the operator's manual for a specific type or make of post-hole digger.

5. The digger will penetrate the soil about three and one-half feet unless an extension is used. It will bore holes from about 4 to 12 inches in diameter.

6. Post-hole diggers are mounted on the rear of the tractor.

7. The post-hole digger drive rod is connected to the power take-off; therefore, the turning movement of the auger is powered by the tractor take-off power. Hydraulic pumps force the digger down and lift it up. These pumps also furnish power to force the digger into the soil.

Answer Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Special Equipment

TOPIC: Crop Drying Equipment

1-4. The student should answer questions asked by the teacher on the make or model of equipment deemed necessary in the assignment.

5. Heated air was used to color the tobacco leaves.

6. Sweet potatoes and hay were among the first crops dried by heated air.

7. Continuous flow dryers are usually considered horizontal or tower dryers that are installed in a permanent location. Batch dryers can be moved to a location where they are needed.

8. A heat exchanger is made up of two main units, heating and air movement. It is not a crop dryer, but the main part of the dryer. When using a direct type unit, cold air is drawn past the burner and flame, and the hot air and gases are blown through the crop.

9. Moisture content for storage of the following crops is:

Shelled corn 13%, wheat 13%, sorghum 12%, rice 13%, oats 13%, and peanuts 7 to 9%.

Answer Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Special Equipment

TOPIC: Forage Blowers

1-4. The student should answer questions prepared by the teacher from the forage blower operator's manual.

5. The unit is usually attached to the forage machine. The blower fan may be made up of six blades fastened to a solid plate wheel or a hub. These paddle blades turn very close to the blower housing. Their function is to separate the crop for easy feeding. The delivery spout may be round, square, or rectangular in shape. It also may be curved or almost straight. It will usually be equipped with a swivel deflector at the top in order that the operator can direct the flow of the feed to any part of the wagon or forage box.

6. The parts are: cutter bar, pick-up attachment, chopping rotor, cross auger, blower fan, and delivery spout.

7. Most blowers are either PTO-driven or driven by a mounted gasoline engine.

8. The PTO-driven unit with an over-running clutch permits the operator to shift into gear after the cutting mechanism is speeded up. After the PTO shaft is disconnected, the over-running clutch permits the blower to remove the forage from the machine.

9. The parts are: conveyor unit, auger and retarder, blower fan, and delivery spout.

Answer Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Special Equipment

TOPIC: Tractor - Mounted Loaders

1-4. The teacher may prepare questions for the student from the operator's manual.

5. Most loaders have two booms that are mounted so that the loader is operated from the tractor front end. Loaders of this type are hydraulically operated.

6. The capacity of a tractor-mounted loader is the lifting of a maximum load in the bucket to the complete height of the loader. The carrying capacity is considered the weight in pounds that can be lifted three feet from the surface and moved to another location.

7. Parts include: piping, reservoir tank, pump, shutoff valve, spool valve, relief valve, piston, and cylinder.

8. The capacity of the pump more or less determines the speed of operation. It is measured in gallons per minute at a certain speed and at specified pounds per square inch pressure.

9. Loader bucket capacity is given in cubic feet.

10. The main parts include: bucket, dump cylinder, lift arms, lift cylinder, control valve, and side frame.

Answer Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Special Equipment

TOPIC: Chain Saws

1-4. It will be necessary for the teacher to develop questions from the operator's manual which the student has studied.

The following will serve as an example:
A portable power saw has this problem: The chain oiler fails to deliver oil to the bar and chain. List the probable causes and remedies.

5. The source of power of a chain saw is similar to a lawn mower. Both machines have internal combustion engines.

6. Intake, compression, ignition, power, and exhaust

7. Direct drive saws operate at 6,000 to 9,000 RPM. The speed will usually depend on the load.

8. Oil and cleanliness

Answer Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Special Equipment

TOPIC: Feed Distribution Equipment

1-2. The teacher may prepare questions for the student from the equipment information manual.

3. Electric bunk distributors:
   a. Proportional drop auger
   b. Revolving tube auger
   c. Swinging conveyor
   d. Tapered bed chain conveyor
   e. Shaker trough
   f. Open-bottom auger
   g. Bunk-feeder wagon

4. A flip-board turns the flow of feed.

5. A swinging conveyor system is used in a circular bunk feeding system.

6. A fast return stroke will advance the feed forward.

7. The open-bottom auger system was the first feed distribution system developed.

8. Bunk-feeder wagons are convenient to use along fencelines.

Topic Test
on
THE MACHINERY INDUSTRY AND ITS IMPORTANCE IN AMERICAN AGRICULTURE

Student: ______________________ School: ______________________

Date: ______________________ Score: ______________________

PART I: Answer the following questions:

1. List the important dates in the development and use of equipment.

   a. __________ cast-iron moldboard plow.

   b. __________ Two-row corn planter patented.

   c. __________ First cultivator sold on market.

   d. __________ Invention and production of the combine.

   e. __________ Horses began to be used as equipment power.

   f. __________ and __________ First successful tractors developed.

   g. __________ Equipment mounted on tractors.

PART II: True or False:

______ 1. The corn picker was invented in 1843.

______ 2. After 1830 horses were used as the main source of power for farming.

______ 3. In 1920 the average farmer commanded about 50 horsepower.

______ 4. Tractors were used extensively after World War I.

______ 5. Early tractor equipment was attached to the drawbar.

______ 6. Even though the equipment industry is considered very important to the farmer, it does not affect our economy and way-of-life.

______ 7. Man's oldest enemy is famine.

UNIT: Introduction
TOPIC: The Machinery Industry and Its Importance in American Agriculture
(Topic Test continued)

_____ 8. World grain stocks have declined due to consumption of grain exceeding production.

_____ 9. About 65 percent of the income in underdeveloped countries comes from farming.

_____ 10. Sixty years ago one farmer could produce enough food for himself and seventeen other people.

_____ 11. Farm production is continuing to increase.

_____ 12. The number of farms is increasing in most states and the size of farms is remaining about the same.

_____ 13. The farmer produces mechanical energy.

_____ 14. Agriculture is considered one of the largest industries in the United States.

_____ 15. Only a few equipment inventions and patents were recorded during the 1800's.

Topic Test
on
AGRICULTURAL MECHANICS AS AN OCCUPATION

Student: ______________________ School: ______________________

Date: ______________________ Score: ______________________

Answer the following questions:

1. List the positions found in a dealership service department.

2. Give the number of people employed in 16,000 dealerships in the United States, the number of manufacturing plants, and the amount of income dealers receive from sales and service.

3. List at least five jobs that a mechanic or mechanic's helper may be involved in while repairing equipment.

4. List several large machines that a farm machinery repairman must be qualified to overhaul or work on.

5. What are three assets of a good mechanic or repairman?

Topic Test
on
SAFETY - SHOP AND EQUIPMENT

Student: ______________________________ School: ______________________________

Date: ______________________________ Score: ______________________________

PART I: Fill in the blanks.

1. ______________ to ______________ per cent of all accidents are caused by human carelessness.

2. The purpose of shop rules is to protect the ______________ while the job is being performed.

3. There are about ________________ disabling injuries each year in the agricultural industry.

4. A _________________ shop is usually a safe shop.

5. A ___________________ is used to protect the individual from inhaling paints.

6. _________________ are used to protect the eyes while grinding metal.

7. Most shop fires are caused by ___________________ of the individual.

8. ____________ tools should be used by experienced employees.

9. An electrician considers all wires as __________________ wires.

10. The best guide to follow to operate a machine properly is the _______________ _______________.

PART II: Place a T by the correct statements and an F by the false statements.

______ 1. All shop rules pertain to shop safety practices.

______ 2. The major purpose of a repair shop is to give service to the dealer.

______ 3. The agricultural industry leads all other industries with the largest number of injuries caused by accidents.

______ 4. Goggles should be worn when doing a small arc welding job.

UNIT: Introduction
TOPIC: Safety - Shop and Equipment
(Topic Test continued)

_____ 5. When lifting a heavy object by hand, bend the legs instead of the back.

_____ 6. In the color code safety system, yellow means danger areas.

_____ 7. First aid equipment is marked by the color green.

_____ 8. A sharp tool is considered more dangerous than a dull tool.

_____ 9. Overloading a hand power tool may cause the fuse to blow.

_____ 10. It is not necessary to treat minor injuries immediately after they happen.

Topic Test
on
MECHANICAL TOOLS - IDENTIFICATION AND USE

Student: ______________________ School: ______________________

Date: ______________________ Score: ______________________

PART I: Fill in the blanks.

1. The ____________ micrometer is used to check the diameter of crankshafts.

2. Measurements are found on the ____________ and ____________ of a micrometer.

3. The two major types of micrometer measurements are graduated in hundredths of a ____________ and ____________ of an inch.

4. The value between the unnumbered lines on the barrel is ____________.

5. The vernier scale reading is taken where the vernier scale line coincides with the ____________ line.

6. What is the total reading on a micrometer if the following numbers are visible:

Highest figure visible	3
Two additional lines visible	2
Two lines above 0 on thimble visible	2

7. Feeler gauges are used to check clearances between ____________ parts.

8. A dial gauge can measure movements in ____________ of an inch.

9. Dividers are used to make ____________ and ____________ measurements.

10. Calipers are used to measure ____________ and ____________ surfaces.

PART II: Place a T by the true statements and an F by the false statements.

_____ 1. Calipers are used when accuracy is not considered critical.

_____ 2. The depth of an opening cannot be determined by using a micrometer.

_____ 3. Lock grip pliers should not be used to hold nuts or round objects.

_____ 4. A hammer made of brass is considered a soft hammer.

UNIT: Introduction
TOPIC: Mechanical Tools - Identification and Use
(Topic Test continued)

_____ 5. The correct way to use most files is to push and pull them across the work.

_____ 6. A rasp cut file has independent teeth.

_____ 7. The diamond point cold chisel is used for most metal cutting jobs.

_____ 8. The starting punch is used to scar metal for drilling holes.

_____ 9. The taper tap can be used in holes where the threads extend to the bottom.

_____ 10. An Allen wrench is considered a setscrew wrench.

Topic Test
on
USE OF HOLDING DEVICES, JACKS,
LIFTS, AND HYDRAULIC PRESSES

Student: ____________________ School: ____________________

Date: ____________________ Score: ____________________

Place a T by the true statements, and an F by the false statements.

_____ 1. One of the commonly used hand jacks is the hydraulic type.

_____ 2. The most commonly used hand operated hydraulic jack has a capacity between 3,000 and 10,000 pounds.

_____ 3. The hand operated hydraulic jack is used entirely for lifting heavy loads.

_____ 4. The floor type hydraulic jack is used only to raise front, rear, and sides of machines and equipment.

_____ 5. There are nine major parts of a floor-type hydraulic jack.

_____ 6. Jack stands are used mainly to hold loads after the load is raised by a jack or hoist.

_____ 7. Some types of floor lifts are both air and hydraulically operated.

_____ 8. A chain hoist is always operated by pulling the chain with the hands.

_____ 9. "A" frames are usually equipped with trolleys.

_____ 10. Heavy duty hoists may lift 20,000 pounds.

_____ 11. A hydraulic press should not be used to remove a bearing from an axle.

_____ 12. A five ton hydraulic press is adequate for most repair shops.

_____ 13. The hydraulic power unit is operated exactly in the same manner as the hand operated hydraulic jack.

_____ 14. The portable hydraulic power unit resembles a rod or series of rods, one projecting out of the other.

_____ 15. A repair stand is not considered a very important piece of equipment.

Topic Test
on
USE OF EQUIPMENT MANUALS

Student: ______________________ School: ______________________

Date: ______________________ Score: ______________________

Place a T by the true statements and an F by the false statements.

_____ 1. The repairman should use the service manual in the shop.

_____ 2. There are five different types of service manuals suitable for shop use.

_____ 3. A service manual is always presented to the purchaser of equipment.

_____ 4. The operator's manual should always be used by the repairman.

_____ 5. The operator's manual fails to give any specifications on the equipment.

_____ 6. One way to prolong the life of a piece of equipment is to follow instructions found in the operator's manual.

_____ 7. Service manuals are published by technical publishing companies.

_____ 8. Operator's manuals may be used as a reference in the repair shop.

_____ 9. A service manual usually refers to one particular machine.

_____ 10. A shop manual is absolutely necessary in a repair shop.

_____ 11. Certain adjustments can be made on equipment by following the instructions in the operator's manual.

_____ 12. A correct name of equipment and model is given in the service manual.

_____ 13. General operation and maintenance manuals give specifications and brand names of belts, bearings, and other equipment parts.

_____ 14. General operation manuals may explain adjusting and controlling the movement of machines.

_____ 15. The general operations manual is used for all types of repair jobs on a piece of machinery or equipment.

Topic Test
on
EQUIPMENT INSPECTION

Student: ______________________ School: ___________________________

Date: ________________________ Score: ____________________________

PART I: Place a T by the statements that are true and an F by the statements that are false.

______ 1. Farm machinery and equipment should be checked only at the end of the working season.

______ 2. The main reason to inspect a piece of equipment is to replace broken parts.

______ 3. It is important that an inspection form be used when inspecting a planter.

______ 4. The beams should be inspected when checking a disk harrow.

______ 5. Machines such as hay balers and combines are to be checked throughout the working season.

______ 6. There are less parts to check on combines than on modern planters.

______ 7. Fertilizer distributors and sprayers usually receive better care than most field equipment.

______ 8. The owner's lack of knowledge of a piece of equipment does not necessarily affect its condition.

______ 9. Time is usually not a factor in checking the condition of equipment.

______ 10. When using an inspection form, the name of the part to be replaced is all the information that is necessary.

PART II: Fill in the following blanks to make true, complete statements:

1. Scrapers are usually found on __________ plows.
2. Hoppers which contain many moving parts are found on __________.

UNIT: Introduction
TOPIC: Equipment Inspection
(Topic Test continued)

3. Shovels and sweeps are found on ______________.

4. A plunger is found on a _________ _________.

5. Combines are similar to _________ _________ in that they are made up of many moving parts.

6. A ___________ should be checked for pitman wear.

7. Clutch action should be checked on a ___________ mower.

8. Elevators and augers need repairing occasionally on a ____________.

9. ___________ distributors are cleaned after each job.

10. Machines under _____________ will usually be inspected by the dealer.

Topic Test
on
FASTENERS USED ON EQUIPMENT

Student: ______________________ School: ______________________

Date: ______________________ Score: ______________________

PART I: Identify the types of bolts and the types of nuts using numbers that are listed on the machine fastener pages.

1. Bolts

a. ______________________ d. ______________________

b. ______________________ e. ______________________

c. ______________________

2. Nuts

a. ______________________ f. ______________________

b. ______________________ g. ______________________

c. ______________________ h. ______________________

d. ______________________ i. ______________________

e. ______________________

PART II: Identify lock washers and lock nuts.

1. ______________________

2. ______________________

3. ______________________

PART III: Identify the different types of thin metal fasteners.

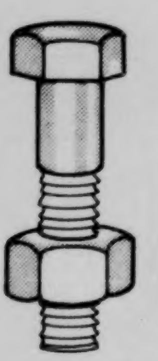
1. ______________________ 6. ______________________

2. ____________________
3. ____________________
4. ____________________
5. ____________________

7. ____________________
8. ____________________
9. ____________________
10. ____________________

PART I

BOLTS



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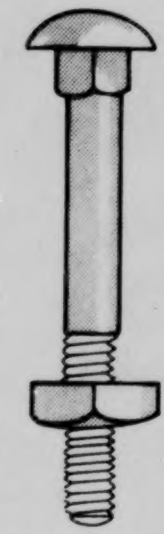

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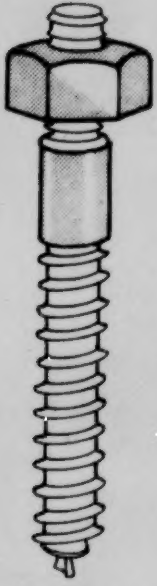

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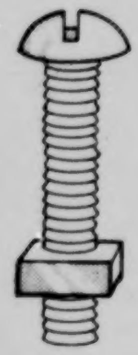

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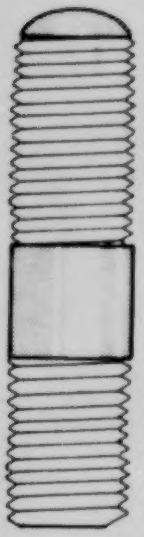

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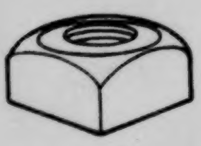
NUTS



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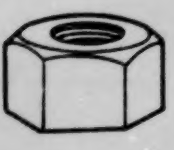

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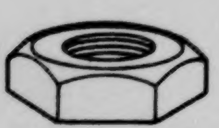

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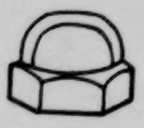

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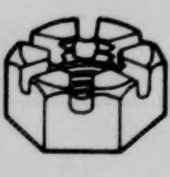

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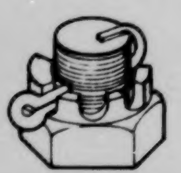

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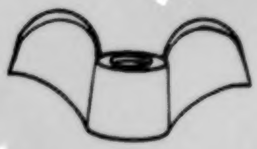

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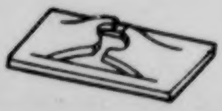

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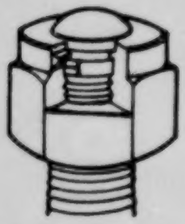

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PART II

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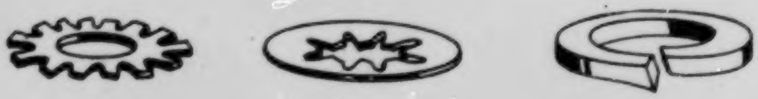

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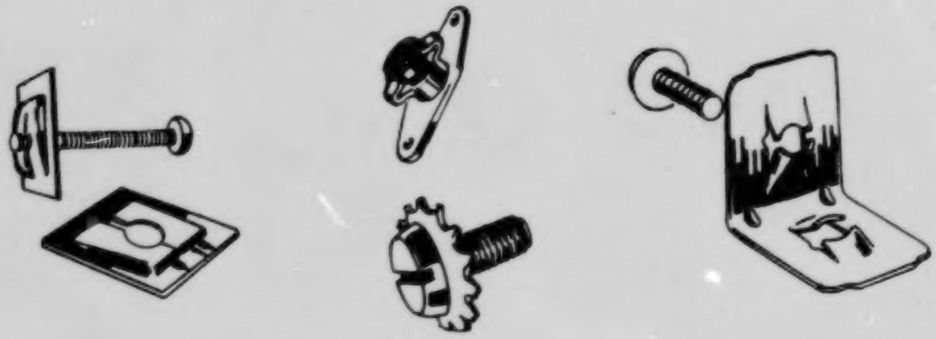

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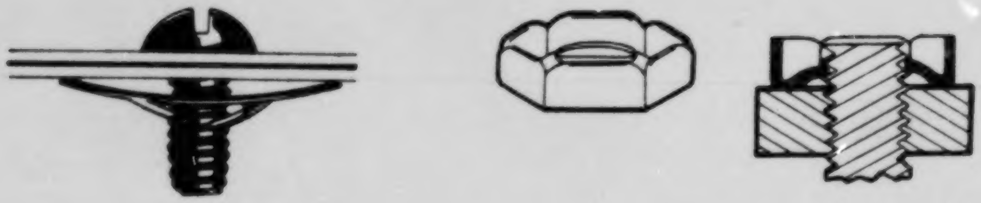

PART III

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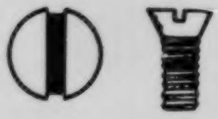

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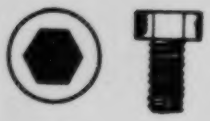

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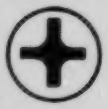

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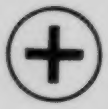

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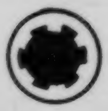

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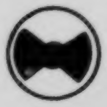

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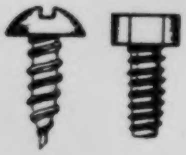

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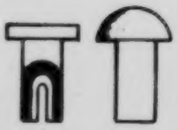

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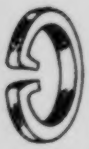

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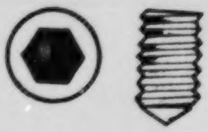


Topic Test
on
THE FUNCTION AND TYPES OF BEARINGS USED ON EQUIPMENT

Student: ______________________ School: ______________________

Date: ______________________ Score: ______________________

True or False:

______ 1. Babbit bearings were made of a mixture of lead, copper, and aluminum.

______ 3. Bearings are used mainly to make moving parts of a machine operate more smoothly.

______ 3. There are only two major types of bearings.

______ 4. The antifriction bearing is referred to as a bushing or plain bearing.

______ 5. A split bearing is made to support thrust or radial loads.

______ 6. Certain types of antifriction bearings are made to handle radial, thrust, and a combination of radial and thrust loads.

______ 7. The ball bearing is the only basic type of antifriction bearing.

______ 8. Bearings that are identified by similar code are generally alike.

______ 9. Antifriction bearings can be identified by the oil groove.

______ 10. The ball race is found on certain types of antifriction bearings.

______ 11. The inner and outer rings are important parts of the friction bearing.

______ 12. One of the most common causes of bearing defects is improper installation.

______ 13. Brinelling is a defect found on antifriction bearings.

______ 14. Dented shields and cages are defects that are caused mainly by removing and installation practices.

______ 15. Antifriction bearings are more easily removed than friction bearings.

______ 16. Special tools are usually required to remove antifriction bearings.

Topic Test
on
GASKETS, SEALS, AND SEALANTS FOR FARM EQUIPMENT

Student: ______________________ School: ______________________

Date: ______________________ Score: ______________________

Place a T by the statements that are true and an F by the statements that are false.

_____ 1. Gaskets are static seals.

_____ 2. The smoothness of mating parts does not determine the type of gasket material that is used.

_____ 3. Special treated paper type gaskets are used on some cooling systems.

_____ 4. Gaskets must be purchased as single units.

_____ 5. Gas tight seals can be formed by using solid metal gaskets.

_____ 6. Spiral wound gaskets are usually made of metal and asbestos.

_____ 7. Anytime a gasket is removed it should be replaced with a new gasket.

_____ 8. Radial lip seals are used exclusively to keep dirt out of moving parts.

_____ 9. Ring seals are found on the outside of shafts.

_____ 10. Compression packings are types of seals.

_____ 11. A diaphragm is considered to be an important seal.

_____ 12. Sealants protect equipment parts against dirt.

_____ 13. Sealants should not be used to hold gaskets in place when working on equipment.

_____ 14. There is only one type of hardening sealant.

_____ 15. Tapes are considered as sealants if they are not cut to size.

_____ 16. Nonhardening sealant should be applied to low-stress joints.

_____ 17. Some sealants may be applied by a trowel or paint brush.

Topic Test
on
PAINTING EQUIPMENT AND MACHINES

Student: ______________________ School: ______________________

Date: ______________________ Score: ______________________

1. What are some advantages of painting farm equipment?
2. How are small parts cleaned?
3. How is the alkaline compound removed from equipment parts after they have been removed from the hot solution bath?
4. Why is a solvent recommended in the steam cleaning process?
5. Discuss the cold soak cleaning method.
6. How is paint removed?
7. Why is spray painting more economical than brush painting?

Topic Test
for
IMPORTANCE OF WELDING AND IDENTIFICATION OF METALS

Student: ____________________ School: ____________________

Date: ____________________ Score: ____________________

Fill in the blanks:

1. __________ can be used to weld iron, steel, brass, copper, aluminum, cast iron, and special alloys.

2. A flame of intense heat is generated as the __________ current passes through a highly resistant __________ gap.

3. One of the main purposes of the flux on an electrode is to furnish a __________ __________ __________.

4. One of the most commonly used types of welding rods is made of __________ __________.

5. When welding metal 1/8" thick, using a 1/8" electrode, the amperage should be __________.

6. When using a welding tip (orifice) 69 and a 1/16" bronze rod, the sheet steel to be welded should be about __________ thick.

7. Joints should be __________ when welding heavy steel plates.

8. Equipment parts such as some gears, gear boxes, and frames are made of __________ iron.

9. Aluminum __________ at high temperature.

10. Many farm equipment machine bodies are made of __________ __________.

11. __________ welding resembles soldering in that the base metal does not fuse with the rod metal.

12. A __________ weld loses its strength if subjected to temperatures above 500 degrees F.

UNIT: Introduction
TOPIC: Importance of Welding and Identification of Metals
(Topic Test continued)

13. Metal applied to the surface of a plow point is known as __________ __________ welding.

14. The __________ position is used more than any other position in welding.

15. Thick metal is __________ before it is welded.

Topic Test
on
TIRES AND WHEEL RIMS

Student: ______________________ School: ______________________

Date: ______________________ Score: ______________________

Answer true or false.

_____ 1. The tire beads are the foundation of the tire.

_____ 2. All off-the-road tires are ply rated.

_____ 3. In bias ply tires the alternate plies run in the same direction.

_____ 4. Belted bias plies surround the entire body of the tire.

_____ 5. A tubeless innerliner may serve as an air retainer.

_____ 6. The tire code found on the side of the tire is made up of only numbers.

_____ 7. Tire flaps are used on tubeless tires.

_____ 8. There is only one type of pressure gauge for checking the air pressure of implement tires.

_____ 9. Underinflation of tires may cause excessive wear in the center of the tire.

_____ 10. Overinflation may cause the tire to slip on certain surfaces.

_____ 11. Underinflated tires may cause damage to the valve stem.

_____ 12. Underinflation is considered more damaging to the tire than overinflation.

_____ 13. The main cause of tire cuts is machinery contact.

_____ 14. Tire moisture has little effect on the tire cord or fabric.

_____ 15. Overloading damages tire tread more than the sidewalls.

_____ 16. A tire should carry below normal pressure on hard surface roads.

_____ 17. There are four major types of tractor and implement rims.

Topic Test
on
TUBING AND HOSES

Student: ______________________ School: ______________________

Date: ______________________ Score: ______________________

Answer the following questions by filling in the blanks.

1. __________ units that are found on drag type equipment raise and lower the equipment.

2. The function of tubing and hose is to transfer __________, __________ and __________.

3. Normally __________ and __________ tubing are used on most farm machines.

4. __________ is not used for brakes.

5. __________ tubing will not withstand high pressures and excessive heat.

6. __________ tubing will break under continuous vibration.

7. The angle of flared tubing is usually either __________ or __________ degrees.

8. __________ fittings are not used on high pressure lines.

9. __________ fittings have tapered threads.

10. The base material for hose is __________.

11. Except for the oil return hose, all __________ hoses operate under pressure.

12. A 3/8 inch high pressure hydraulic hose may operate at __________ pounds of pressure per square inch.

13. A two-inch high pressure hydraulic hose operates at __________ pounds of pressure per square inch.

14. A high pressure hydraulic hose has both a __________ and __________ braid.

15. A compression type of fitting has a __________ on the tubing.

Topic Test
on
MOLDBOARD PLOWS

Student: ______________________ School: ______________________

Date: ______________________ Score: ______________________

PART I: Sketch and name twelve (12) parts of an assembled moldboard plow bottom:

PART II: Fill in the following blanks to make true, complete statements:

1. The ________________ is the space left in the land when the furrow slice is inverted or turned on its side.

2. The _________ is at the center of the bottom, and all the other parts are fastened to it.

3. The __________ is the "business end" of the plow bottom.

4. __________ refers to the ground or earth that has not yet been plowed.

5. When two open furrows come together, the double furrow is called a ______ ______________________________.

Topic Test
on
DISK PLOWS

Student: ____________________ School: ____________________

Date: ____________________ Score: ____________________

Fill in the blanks indicated below:

1. The three types of scrapers are the __________, __________, and __________.

2. List the three main types of plows:

   a. ____________________

   b. ____________________

   c. ____________________

3. The disk plow is comprised of the following parts:

   a. ____________________ d. ____________________

   b. ____________________ e. ____________________

   c. ____________________ f. ____________________

4. List the three types of adjustments common to all types of disk plows:

   a. ____________________

   b. ____________________

   c. ____________________

Topic Test
on
MIDDLEBUSTERS AND LISTERS

Student: ______________________ School: ______________________

Date: ______________________ Score: ______________________

Answer the following questions:

1. Name the five parts of a lister bottom:

    a. ______________________

    b. ______________________

    c. ______________________

    d. ______________________

    e. ______________________

2. List five different types of attachments available for a middlebuster or lister:

    a. ______________________

    b. ______________________

    c. ______________________

    d. ______________________

    e. ______________________

3. How are middlebusters and listers classified? ______________________

4. Name the two types of middlebusters and listers:

    a. ______________________

    b. ______________________

Topic Test
on
ROTARY PLOWS

Student : ____________________ School: ____________________

Date: ____________________ Score: ____________________

Fill in the following blanks to make true, complete statements:

1. What are the three types of rotary plows?

   a. ____________________

   b. ____________________

   c. ____________________

2. The pull auxiliary-engine rotary plow is made in _______-, _______-, and _______-foot sizes and requires _______ to _______ horsepower.

3. The cutting knives or tines are generally mounted on a horizontal power-driven shaft which operates at about _______ r.p.m.

4. The self-propelled garden-type rotary plow plows a strip _______ to _______ inches wide and is powered by _______ to _______ horsepower engine.

Topic Test
on
CHISEL PLOWS AND SUBSOILERS

Student: ______________________ School: ______________________

Date: ______________________ Score: ______________________

Place a T by the True statements and an F by the False statements:

_____ 1. There is some question about the advantages of subsoilers in many areas.

_____ 2. A chisel plow inverts and pulverizes the soil.

_____ 3. A subsoiler works only when the soil is wet or damp.

_____ 4. Because subsoilers work deep, the draft is great.

_____ 5. There are only two kinds of points available for chisel plows.

_____ 6. Subsoilers need less care than other machines.

_____ 7. The shank or standard is the main part of the subsoiler unit.

_____ 8. Subsoilers are available in both trailing and mounted units.

_____ 9. Subsoilers are built heavier than the chisel plows since they are used to penetrate the soil to depths of 20" - 36".

_____ 10. There are only two layers of soil.

Topic Test
on
DISK HARROWS

Student: ____________________ School: ____________________

Date: ____________________ Score: ____________________

Fill in the blanks:

1. The more weight per unit of disk area in contact with the ground, the greater the ______________.

2. ____________________ changes the gang so that it does not roll straight.

3. A ______________ is an assembly of disks all rotating together with a common shaft or bolt through their center.

4. The two main types of disk harrows are __________ and __________.

5. The two main types of harrow disks are __________ and __________.

6. The wood bushings are usually made of __________.

7. To keep the gangs level, special ____________ ________________ ______________ are made for the inner ends of both sections.

8. Lightweight disk harrows generally have two ____________ per gang, while heavy brush and log harrows may have several.

9. ________________ are placed on the disk harrow to clean and remove soil that may stick to the concave side of the disk blades.

Topic Test
on
SPRING-TOOTH HARROWS

Student: ______________________ School: ______________________

Date: ______________________ Score: ______________________

Place a T beside the True statements and an F by the False statements:

_____ 1. The spring-tooth harrow is one of several types called drag harrows.

_____ 2. The spring-tooth harrow is used to prepare land for seed.

_____ 3. There are four main types of spring-tooth harrows.

_____ 4. Lift harrows may have only one section.

_____ 5. The limit to size--number of sections used--would depend on the power of the tractor, the depth desired to work the soil, and the condition of the land.

_____ 6. The four types of spring teeth, according to their use, are regular, quack grass, alfalfa, and renewable-point.

_____ 7. Channel bars, V-clamps, and a set screw are used to attach the teeth to the tooth bar.

_____ 8. There is only one adjustment on tooth penetration.

_____ 9. The center section of a three-section harrow has no runners but depends on the outer sections for support.

_____ 10. Spring-tooth harrows are adapted for use in rough and stony ground.

Topic Test
on
SPIKE-TOOTH HARROWS

Student: ______________________ School: ______________________

Date: ______________________ Score: ______________________

Place a T beside the True statements and an F beside the False statements:

_____ 1. The spike-tooth harrow is often called a peg-tooth harrow.

_____ 2. A spike-tooth harrow differs from a spring-tooth harrow in that the spike-tooth harrow does not come in sections.

_____ 3. Five horizontal bars hold the teeth at definite spacings.

_____ 4. Almost all spike teeth are diamond-shape.

_____ 5. Mounted harrows usually have stabilizer rods extending to some forward point on the tractor.

Topic Test
on
LAND ROLLERS AND PULVERIZERS

Student: ______________________ School: ______________________

Date: ______________________ Score: ______________________

Answer the following questions:

1. The land pulverizers come in __________ and __________ sections.

2. List three different types of tools used to put a finishing touch to the seedbed:

   a. ____________________

   b. ____________________

   c. ____________________

3. Give the primary purposes of land rollers and pulverizers:

   ____

   ____

   ____

   ____

Topic Test
on
ROTARY HOES

Student: ______________________ School: ______________________

Date: ______________________ Score: ______________________

1. The bearing inserts are made of what kind of metal? ______________________
2. At what tractor speed should the rotary hoe be pulled? ______________________ ______________________
3. Are added weights recommended for a rotary hoe? ______________________ ______________________
4. Why is a hitch pipe used between the tractor and the hoe? ______________________ ____
5. Can broken or worn wheels be replaced? ______________________

Topic Test
on
GRAIN DRILLS

Student: ______________________ School: ______________________

Date: ______________________ Score: ______________________

Place a T beside the True statements and an F by the False statements:

_____ 1. A grain drill sows grain or seed efficiently and in correct amounts at the proper depth and in drills or rows.

_____ 2. The size of drills is expressed only by overall width.

_____ 3. The bottom of the seed hopper is fitted with cups, one for each furrow opener.

_____ 4. The seed rate of flow on a grain drill cannot be changed.

_____ 5. The flow of seeds can be controlled by varying the opening of the run.

_____ 6. There are four types of furrow openers.

_____ 7. All drills have seed coverers.

_____ 8. One of two types of axles is used on most grain drills.

_____ 9. The steel hopper is found on most grain drills.

_____ 10. Grass seeding attachments cannot be attached to a grain drill.

Topic Test
on
ROW-CROP PLANTERS

Student: ____________________ School: ____________________

Date: ____________________ Score: ____________________

Answer the following questions:

1. What are the two main types of row-crop planters?

   a. ____________________

   b. ____________________

2. List the four variables in securing a good stand of any crop.

   a. ____________________ c. ____________________

   b. ____________________ d. ____________________

3. List three types of constant depth furrow openers.

   a. ____________________

   b. ____________________

   c. ____________________

4. List five types of furrow coverers.

   a. ____________________ d. ____________________

   b. ____________________ e. ____________________

   c. ____________________

5. Give the purpose of markers on a row-crop planter. ____________________

   ____

   ____

Topic Test
on
INTRODUCTION

Student: ____________ School: ____________

Date: ____________ Score: ____________

Place a T by the statements that are True and an F by those that are False.

_____ 1. Most livestock producers need grass for their success.

_____ 2. Row-crop farmers would like to confine grass to the pasture.

_____ 3. The farmer has no primary tools of war on weeds.

_____ 4. The use of chemicals cannot be practiced by farmers for controlling weeds.

_____ 5. Weeds lower the yields of row-crops.

Topic Test
on
CULTIVATORS

Student: ______________________ School: ______________________

Date: ______________________ Score: ______________________

Answer the following questions:

1. What is cultivation? ____

____

____

2. List the six parts of the ground-engaging equipment.

a. ____________________ d. ____________________

b. ____________________ e. ____________________

c. ____________________ f. ____________________

3. Name the two major types of sweeps used on cultivators.

a. ____________________

b. ____________________

4. List three types of attachments available for cultivators.

a. ____________________

b. ____________________

c. ____________________

Topic Test
on
FLAME WEEDERS

Student: ______________________ School: ______________________

Date: ______________________ Score: ______________________

Place a T beside the True statements and an F by the False statements.

_____ 1. The flame weeders are mounted on the tractor with skid supports for the burners.

_____ 2. The burners are mounted at about 60 degrees to 75 degrees angle.

_____ 3. The flame should strike the ground about 6 inches from the plant on the burner side.

_____ 4. Butane is the only fuel used for flame weeders.

_____ 5. The pressure on the fuel line to the burners may range from 30 to 40 pounds.

Topic Test
on
ROTARY SHREDDERS

Student: ____________________ School: ____________________

Date: ____________________ Score: ____________________

Answer the following questions:

1. List at least six uses of the rotary shredder.

   a. ____________________

   b. ____________________

   c. ____________________

   d. ____________________

   e. ____________________

   f. ____________________

2. List the major parts of a rotary shredder.

   a. ____________________

   b. ____________________

   c. ____________________

   d. ____________________

   e. ____________________

3. The two main types of rotary mowers are:

   a. ____________________

   b. ____________________

4. The knives of a rotate shredder operate ____________________ to the ground.

Topic Test
on
HYDRAULIC SPRAYERS

Student: ______________________ School: ______________________

Date: ______________________ Score: ______________________

Answer the following questions:

1. List the three main types of pumps available on hydraulic sprayers.

   a. ______________________

   b. ______________________

   c. ______________________

2. Name the three types of nozzles most commonly used.

   a. ______________________

   b. ______________________

   c. ______________________

3. Most hydraulic sprayers are equipped with a positive ______________________ pump.

Topic Test
on
PUMPS FOR AGRICULTURE SPRAYERS

Student: ______________________ School: ______________________

Date: ______________________ Score: ______________________

Answer the following question:

1. Name the six types of pumps used on agricultural sprayers.

a. ______________________

b. ______________________

c. ______________________

d. ______________________

e. ______________________

f. ______________________

Topic Test
on
BLOWER SPRAYERS

Student: ____________________ School: ____________________

Date: ____________________ Score: ____________________

Place a T beside the True statements and an F by the False statements.

_____ 1. The blower sprayer is a relatively new sprayer.

_____ 2. Blower sprayers are used primarily on field crops such as oats, wheat, and barley.

_____ 3. These machines are similar in many ways to the power dusters.

_____ 4. A high-volume, high-pressure pump is generally used on a blower sprayer.

_____ 5. Blower type sprayers are generally automatic; only the tractor operator is needed.

Topic Test
on
DUSTERS

Student: ______________________ School: ______________________

Date: ______________________ Score: ______________________

1. Make a sketch of a power duster and name the parts. Students should refer to sketch in workbook for this question.

Topic Test
on
CALIBRATING SPRAY EQUIPMENT

Student: ____________________ School: ____________________

Date: ____________________ Score: ____________________

Place a T beside the True statements and an F by the False statements.

_____ 1. Nozzle spacing on the boom is a factor which governs the amount of spray applied.

_____ 2. Ground speed of the spray machine is a factor which governs the amount of spray applied.

_____ 3. Pressure at the nozzle is a factor which governs the amount of spray applied.

_____ 4. Nozzle orifice size is a factor which governs the amount of spray applied.

Topic Test
on
MANURE SPREADERS

Student: ____________________ School: ____________________

Date: ____________________ Score: ____________________

Answer the following questions:

1. The chief difference between types of manure spreaders is the __________ method used.
2. Nearly all boxes are ____ to ____ inches wider at the rear than at the front.
3. There are several factors to consider in selecting a spreader. List three of these factors:

   a. ____________________

   b. ____________________

   c. ____________________
4. What conveys the manure to the rear of the spreader? ____________________
5. The best chain in most manure spreaders is the __________ chain.

Topic Test
on
DRY FERTILIZER DISTRIBUTORS

Student: ______________________ School: ______________________

Date: ______________________ Score: ______________________

Place a T beside the True statements and an F by the False statements.

_____ 1. The end wheel fertilizer distributor (or spreader) distributes all types of solid fertilizers at a uniform rate over a wide range of conditions.

_____ 2. The width of the hopper is a very good indication of the size of the machine and the swath it will sow.

_____ 3. The agitator is the device that forces the material through the parts.

_____ 4. The rotor is a separate upper rod for agitating the material and keeping it from bridging in the hopper.

_____ 5. Some machines will sow grass seed if the rotor is changed.

_____ 6. The hopper holds the fertilizer.

_____ 7. Only one type of hopper is available.

_____ 8. Cleanliness is important when storing a fertilizer distributor.

_____ 9. A 50-50 mixture of used crankcase oil and kerosene or fuel oil is good to paint the machine with, after use and before storing.

_____ 10. Rust preventive is good to use when putting the machine away for a season.

Topic Test
on
LIQUID AND GAS FERTILIZER EQUIPMENT

Student: ______________________ School: ______________________

Date: ______________________ Score: ______________________

Place a T beside the True statements and an F by the False statements:

_____ 1. Liquid fertilizer equipment is available in high- and low-pressure and non-pressure forms.

_____ 2. Anhydrous ammonia exists as a gas at all times.

_____ 3. The metering device regulates the flow of anhydrous ammonia to the desired rate per acre.

_____ 4. Brass and copper fittings are not to be used with anhydrous ammonia equipment.

_____ 5. Tanks may be lined with rubber, neoprene, polyethylene, and vinyl resins.

Topic Test
on
INTRODUCTION

Student: ______________________ School: ______________________

Date: ______________________ Score: ______________________

Fill in the proper number which corresponds to the part of the combine as illustrated in the attached sketch.

_____ Chaffer

_____ Grain trough

_____ Cylinder

_____ Platform auger

_____ Cylinder beater

_____ Tailings auger

_____ Grain auger

_____ Reel

_____ Feeder

_____ Cleaning fan

_____ Knife

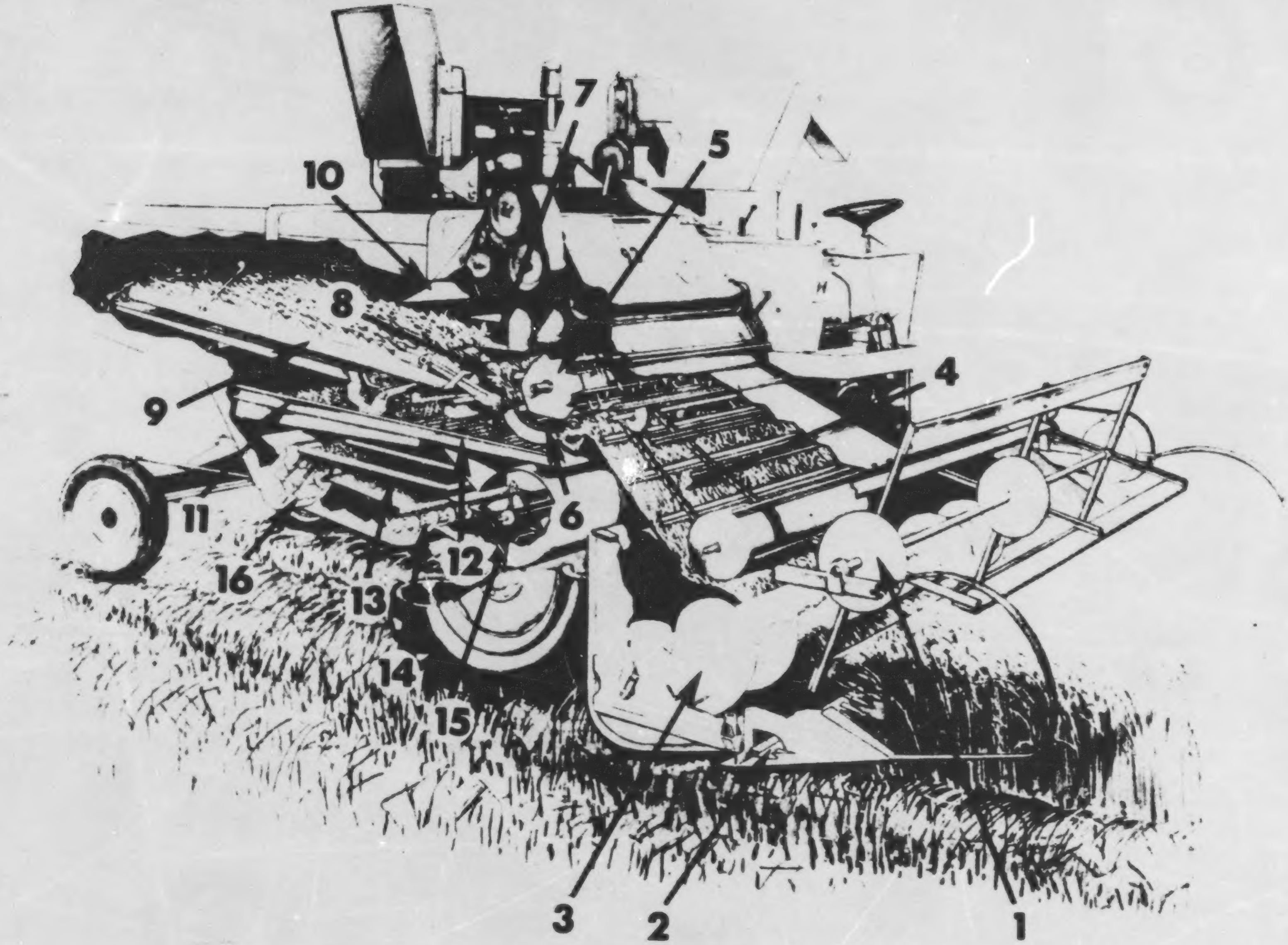
_____ Concave grates

_____ Finger grate

_____ Straw rack

_____ Shoe sieve

_____ Cylinder beater check flap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COMBINE OPERATING CYCLE

Topic Test
on
CUTTING, FEEDING, AND THRESHING MECHANISMS

Student: ______________________ School: ______________________

Date: ______________________ Score: ______________________

PART I: Identify the following parts which correspond to the numbers on the attached sketch:

Part 1 - ______________________ Part 5 - ______________________

Part 2 - ______________________ Part 6 - ______________________

Part 3 - ______________________ Part 7 - ______________________

Part 4 - ______________________

PART II: True or False:

______ 1. The reel holds the grain against the knife.

______ 2. The dividers cut the head of the grain from the stem.

______ 3. The platform holds the cutter bar and feeding mechanism.

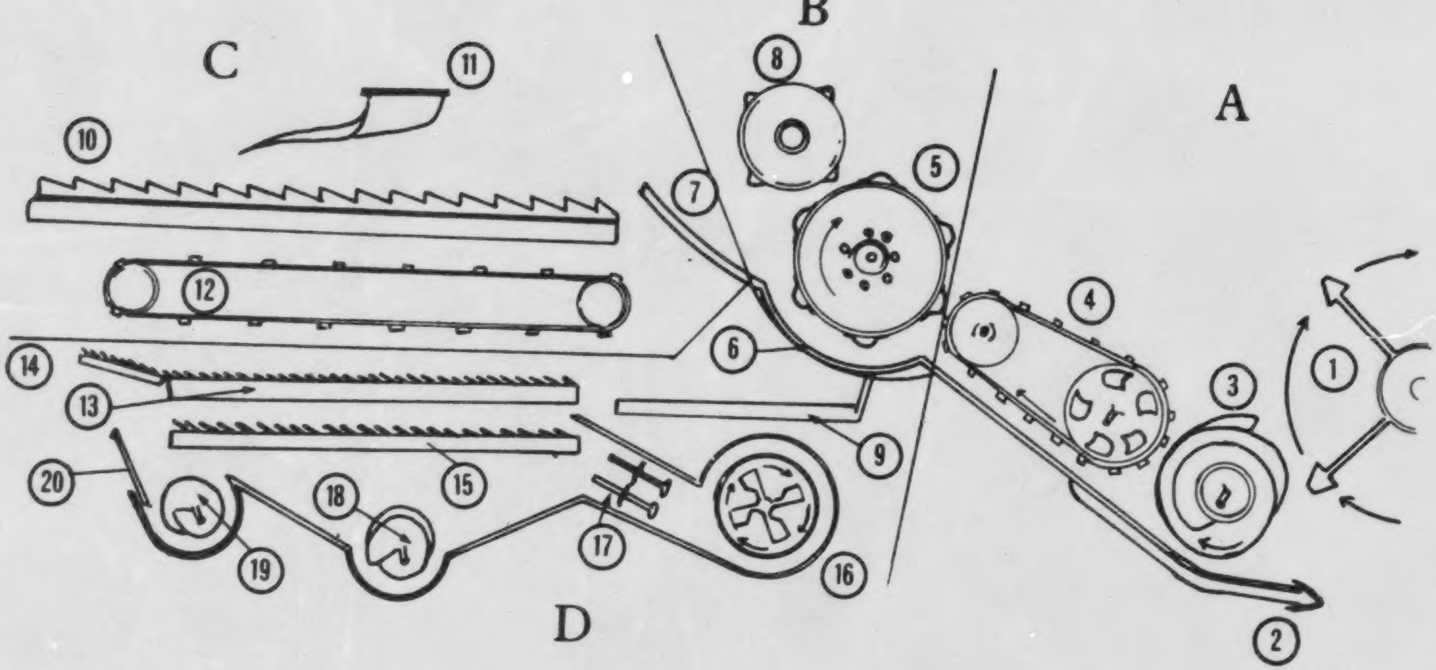
______ 4. Feeder conveyor feeds the grain steadily and evenly into the threshing unit.

______ 5. The cylinder can have only spikes that will cause the rubbing of the grain against the concave.

______ 6. The concave is the stationary part that the cylinder works against.

______ 7. One of the functions of the cylinder beater is to slow down the material coming from the cylinder.

COMBINE CROSS SECTION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Topic Test
on
COMBINE SEPARATING AND CLEANING MECHANISMS

Student: ____________________ School: ____________________

Date: ____________________ Score: ____________________

PART I: Identify the following parts which correspond to the numbers on the attached sketch:

Part 8 - ____________________ Part 15 - ____________________

Part 9 - ____________________ Part 16 - ____________________

Part 10 - ____________________ Part 17 - ____________________

Part 11 - ____________________ Part 18 - ____________________

Part 12 - ____________________ Part 19 - ____________________

Part 13 - ____________________ Part 20 - ____________________

Part 14 - ____________________

PART II: True or False:

_____ 1. The straw rack dispenses the straw out of the rear of the machine.

_____ 2. The check flap lets the straw and grain go over the straw rack undeflected.

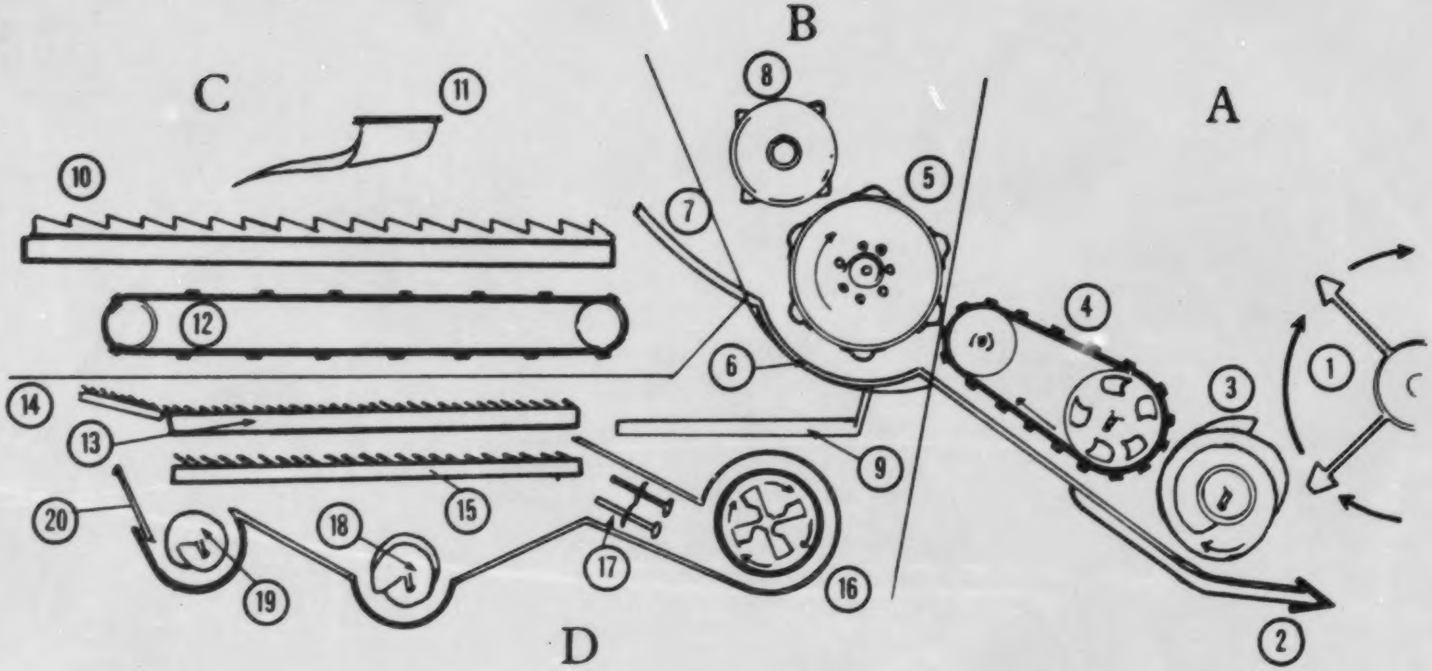
_____ 3. The grain pan catches the unthreshed heads and returns them to the cylinder.

_____ 4. The adjustable chaffer acts as a sieve.

_____ 5. The tailboard lets the unthreshed material be carried out the rear of the combine.

_____ 6. The cleaning fan furnishes a blast of air to keep the material "alive" on the chaffer and sieve.

_____ 7. The clean grain auger collects clean grain and augers it to the clean grain elevator.


A
B
C
D

Topic Test
on
GRAIN HANDLING UNIT AND COMBINE ATTACHMENTS

Student: ____________________ School: ____________________

Date: ____________________ Score: ____________________

PART I: True or False:

_____ 1. The power-driven unit conveys the threshed, cleaned grain to the point where it is taken from the combine.

_____ 2. The clean grain auger collects the clean grain at the bottom of the shoe and conveys it across the combine to the elevator.

_____ 3. Normally, the capacity of a grain tank is 5-10 bushels.

_____ 4. The power-driven auger unloads the grain tank.

_____ 5. Where it is customary to sack the grain, a two-spout bagger attachment replaces the grain tank.

PART II: Fill in the following blanks to make true, complete statements.

1. The combine can be converted from small grains to shelled corn harvesting by replacing the small grain unit with the corn __________ attachment.
2. A __________ removes weed seed from the grain.
3. A self-propelled rice combine is different from a regular combine in that the size and arrangement of __________ are different.
4. Grain sorghums are harvested with a __________ combine.
5. A windrowing machine knife and reel are operated by the __________.

Topic Test
on
INTRODUCTION TO CORN PICKERS

Student: ______________________ School: ______________________

Date: ______________________ Score: ______________________

Answer the following questions:

1. Name the three kinds of corn pickers.

   a. ______________________

   b. ______________________

   c. ______________________

2. List three types of pickers by the way they receive power.

   a. ______________________

   b. ______________________

   c. ______________________

3. List the five major parts or mechanisms of a corn picker.

   a. ______________________

   b. ______________________

   c. ______________________

   d. ______________________

   e. ______________________

Topic Test
on
GATHERING AND SNAPPING MECHANISMS

Student: ______________________ School: ______________________

Date: ______________________ Score: ______________________

True or False:

_____ 1. The points may also be referred to as the "snout".

_____ 2. In some models, the center divider is steered by the tractor steering wheel.

_____ 3. Only one gathering chain is used per row.

_____ 4. The points pull the stalks into the snapping rolls.

_____ 5. The gathering chains direct the stalks into the throat of the gathering mechanism.

_____ 6. Ears are snapped from the stalk by a pair of long, closely spaced rolls.

_____ 7. The snapping rolls are equipped with spiral lugs.

_____ 8. Each roll has a bearing on the lower end.

_____ 9. Some rolls slant upward and some downward.

_____ 10. The rolls revolve toward each other.

Topic Test
on
HUSKING, CLEANING, AND SHELLING MECHANISMS

Student: ____________________ School: ____________________

Date: ____________________ Score: ____________________

_____ 1. Corn snappers and sweet corn harvesters do have husking units.

_____ 2. There are two types of husking units: continuous and separate.

_____ 3. The separate husking mechanism has a separate drive and is independent of the snapping rolls.

_____ 4. The corn ears are held against the husking rolls by a pressure plate.

_____ 5. One roll is usually rubber or rubber-coated.

_____ 6. Cleaning is accomplished by a mechanical trash ejector and by air blasts.

_____ 7. The air blast from the fan strikes the ears as they leave the husking rolls.

_____ 8. The function of the shelling mechanism is to shell the corn ears as they come from the husking rolls.

_____ 9. A 5/8-inch rasp-bar concave clearance is more desirable than a 3/4-inch clearance.

Topic Test
on
STRIPPERS

Student: ______________________ School: ________________________

Date: ________________________ Score: ________________________

PART I: Fill in the following blanks to make true, complete sentences.

1. All modern cotton strippers are tractor-operated, either ________________ or ____________________.

2. Both ______________ and __________________ sizes are available.

3. There are two main types of cotton strippers, based on the mechanism used for the stripping action. They are __________________________ and __________________________.

4. The two main mechanisms of a cotton stripper are __________________ and __________________________.

5. Several types of rolls and roll materials are used in the different models. The most common is ______________.

PART II: Place a T beside the True statements and an F by the False statements.

_____ 1. Not all cotton strippers are tractor-operated.

_____ 2. Strippers are designed to harvest stormproof or semi-stormproof varieties.

_____ 3. Normal working speed of a stripper is 2-6 miles per hour.

_____ 4. Under good conditions, a two-row model can harvest at the rate of one bale in 10 minutes.

_____ 5. The gathering unit lifts and guides the cotton plants into the strippers.

Topic Test
on
PICKERS

Student: ______________________ School: ______________________

Date: ______________________ Score: ______________________

PART I: Identify the parts on the attached sketch of the picking unit of a cotton picker.

1. ______________________ 5. ______________________

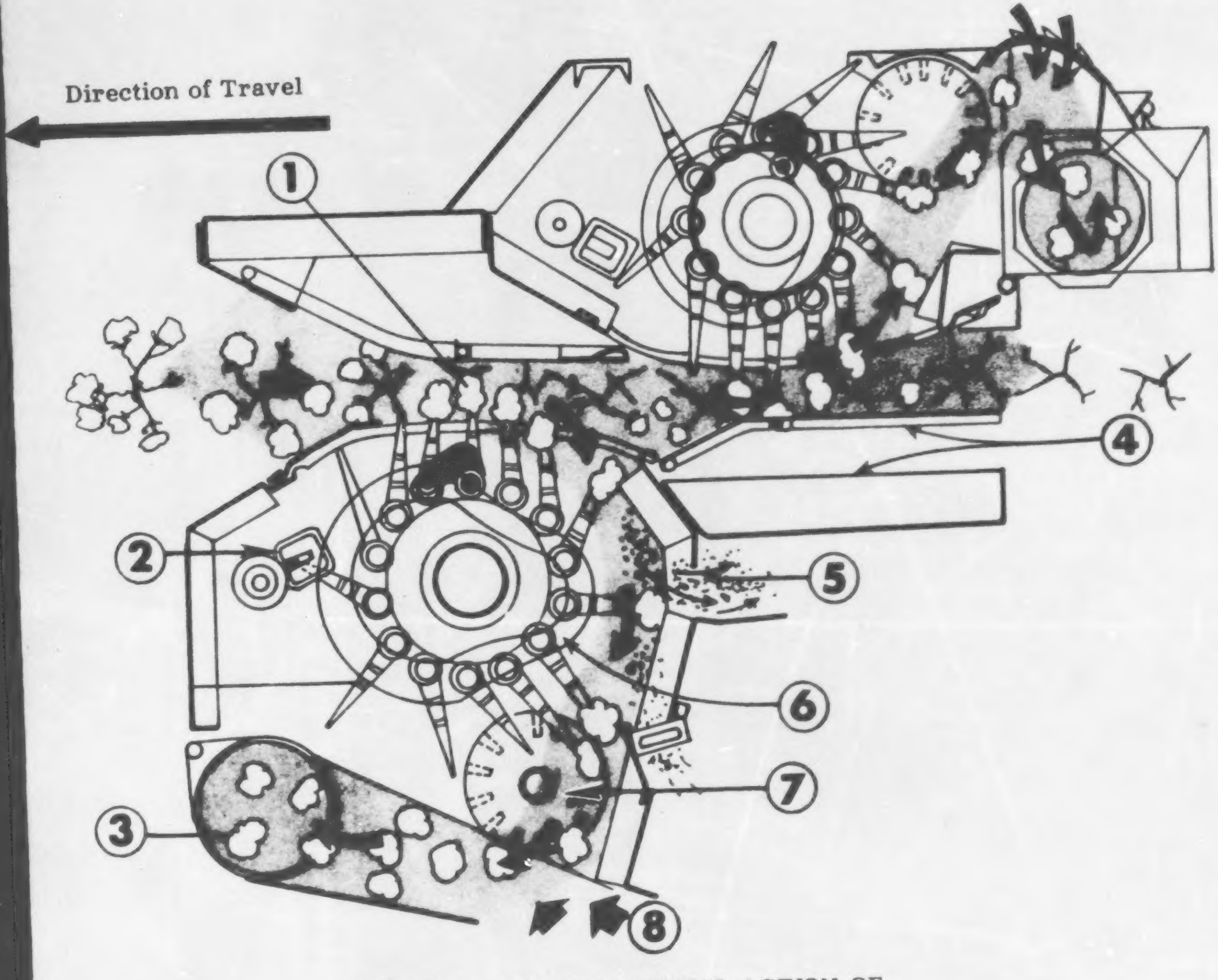
2. ______________________ 6. ______________________

3. ______________________ 7. ______________________

4. ______________________ 8. ______________________

PART II: Fill in the following blanks to make true, complete statements.

1. A single-row machine, under favorable conditions, may pick as fast as ________ hand workers.
2. There are _____- and _____-row machines of both the tractor-mounted and self-propelled types.
3. There are two general arrangements used for mounting and operating cotton picker spindles: the ________ and the ________.
4. Most cotton pickers use __________ for conveying the cotton.
5. The ____________________ remove the cotton from the spindles.


Direction of Travel
①
②
③
④
⑤
⑥
⑦
⑧

OVERHEAD PLAN VIEW OF THE OPERATIONAL ACTION OF COTTON-PICKER SPINDLES PICKING FROM EACH SIDE OF THE ROW

Topic Test
on
MOWERS

Student: ______________________ School: ______________________

Date: ______________________ Score: ______________________

True or False:

_____ 1. The field mower is designed to cut forage crops grown in rows.

_____ 2. The frame supports the drive and cutter bar mechanisms.

_____ 3. The power for a mower comes from the tractor P. T. O.

_____ 4. The yoke is that casting to which the cutter bar is hinged.

_____ 5. The cutter bar can only be raised with a hand lever.

_____ 6. All tractor-mounted mowers need some protection in case the cutter bar strikes an obstruction.

_____ 7. The section or knife actually does the cutting.

_____ 8. The cutter bar is a flat bar 1/2-inch thick.

_____ 9. There is usually only one wear plate per mower.

_____ 10. The pitman is like a connecting rod in an engine.

Topic Test
on
HAY RAKES

Student: ____________________ School: ____________________

Date: ____________________ Score: ____________________

PART I: Fill in the following blanks to make true, complete statements:

1. The ______________ rake is used by more American farmers than other types.

2. There are two types of reel rakes: the ______________ reel rake, and the ______________ rake.

3. The two types of drives for side-delivery rakes are the ______________ and the ______________ drive.

4. Rakes are driven by ______________ or ______________ traction wheels.

5. Some rakes are equipped with ______________ cylinders to raise and lower the rake.

PART II: True or False

_____ 1. The reel height can be adjusted by levers near the tractor.

_____ 2. There are two types of rake frames.

_____ 3. Sweep rakes are most often used to stack hay.

_____ 4. To meet the needs of both small and large farms, manufacturers furnish light-duty and heavy-duty models.

_____ 5. The rake ends can be adjusted up or down.

Topic Test
on
HAY CONDITIONERS

Student: ____________________ School: ____________________

Date: ____________________ Score: ____________________

Place a T beside the True statements and an F by the False statements:

_____ 1. The conditioning of hay by means of crushing, crimping, or flailing is becoming unpopular with hay makers.

_____ 2. One of the disadvantages of the conditioner is that field curing is speeded up.

_____ 3. An advantage of the hay conditioner is that weather damage is reduced.

_____ 4. The smooth-roll type of conditioner may use two rubber rolls or a combination of a rubber roll and a steel roll.

_____ 5. The flail-type conditioner is really a hay harvester, but it can be used as a conditioner.

Topic Test
on
WINDROWERS

Student: ______________________ School: ______________________

Date: ______________________ Score: ______________________

Answer the following questions:

1. Name the two types of windrowers.

   a. ______________________

   b. ______________________

2. Give the power sources of the above types of windrowers.

   a. ______________________

   b. ______________________

3. List the three operations performed by most windrowers.

   a. ______________________

   b. ______________________

   c. ______________________

4. What three implements does the windrower replace?

   a. ______________________

   b. ______________________

   c. ______________________

5. Normally, how many tractors and operators does the windrower eliminate?

   ____

Topic Test
on
BALERS

Student: ____________________ School: ____________________

Date: ____________________ Score: ____________________

PART I: Place a T beside the True statements and an F by the False statements.

_____ 1. The purpose of a hay baler is to pick up hay from a windrow and compress it into a bale.

_____ 2. There are two types of materials used in tying bales--twine and wire.

_____ 3. It is not possible to buy a baler without an engine.

_____ 4. The width of bales varies from 8" to 12".

_____ 5. The pickup mechanism is always on the left side of the baler.

_____ 6. The pickup mechanism varies in width from approximately 3'11" to 6'.

_____ 7. The plunger is a heavy rectangular framework of steel and wood.

_____ 8. The bale chamber is always made of steel.

_____ 9. The tension bars or rails squeeze the bale.

_____ 10. Bale density is the density of the bale in the field after the baler is finished.

PART II: Answer the following questions.

1. Name the four mechanisms of a baler.

a. ____________________ c. ____________________

b. ____________________ d. ____________________

2. How is capacity in a baler expressed? ____________________

____

Topic Test
on
FORAGE HARVESTERS

Student: ______________________ School: ______________________

Date: ______________________ Score: ______________________

PART I: Answer the following questions:

1. List the three types of field choppers used by farmers.

   a. ____________________

   b. ____________________

   c. ____________________

2. Name the three major processes involved in the operation of a forage harvester.

   a. ____________________

   b. ____________________

   c. ____________________

3. What are the two principal types of cutter heads used on forage harvesters?

   a. ____________________

   b. ____________________

PART II: Place a T beside the True statements and an F by the False statements.

_____ 1. The primary purpose of the forage harvester is to chop field crops and place the chopped crop in a wagon.

_____ 2. Clutches are not necessary on the forage harvester.

_____ 3. A smaller engine can be used with a flywheel machine than with a cylinder-equipped machine of similar size.

_____ 4. A conveyor apron is a series of slats fastened to two or three chains.

_____ 5. The row-crop attachment may be one- or two-row.

Topic Test
on
FARM ELEVATORS

Student: ______________________ School: ____________________________

Date: ________________________ Score: _____________________________

Answer or complete the following questions or statements.

1. In general, the elevators used on the farm may be classified as ____________ elevators and ____________ elevators.

2. Name the three types of portable elevators.

   a. ____________________

   b. ____________________

   c. ____________________

3. The ______________________ type elevator is useful where large quantities of grain are handled.

4. What are the two types of hoppers available on a drag-flight elevator?

   a. ____________________

   b. ____________________

Topic Test
on
FEED MILLS

Student: ____________________ School: ____________________

Date: ____________________ Score: ____________________

Place a T beside the True statements and an F by the False statements:

_____ 1. Hammer mills enable the individual farmer to grind feed as the need arises and convenience permits.

_____ 2. The modern hammer mill can grind only roughages.

_____ 3. The only source of power for the hammer mill is electricity.

_____ 4. Most electric motors that operate the hammer mills are from 3 h.p. to 10 h.p.

_____ 5. The first step in preparing the hammer mill for operation is to select the proper screen.

_____ 6. The feed collector is a part of the hammer mill.

_____ 7. When grinding on an extremely fine screen, less air should be drawn through the screen.

_____ 8. When extremely coarse screens are used, the suction slide may be closed entirely.

_____ 9. All hammers must be sharpened, reversed, or replaced at the same time.

_____ 10. Rated speed is of little importance as far as the successful operation of the hammer is concerned.

Topic Test
on
FEED GRINDER-MIXERS

Student: ____________________ School: ____________________

Date: ____________________ Score: ____________________

It will be necessary for the teacher to develop questions from the operator's manual which the student has studied.

The following will serve as an example:

> A grinder-mixer has this problem: The auger feeder runs full, but little or no grain is delivered to the mill. List the possible causes and remedies.

QUESTIONS:

1.

2.

3.

4.

5.

Topic Test
on
POST-HOLE DIGGERS

Student: ______________________ School: ______________________

Date: ______________________ Score: ______________________

It will be necessary for the teacher to develop questions from the operator's manual which the student has studied.

Answer the following questions.

1. List the main uses of the post-hole digger.

   a. ______________________

   b. ______________________

2. List the depth of penetration and the width of hole made by a standard post-hole digger.

   a. ______________________

   b. ______________________

3. Give the mounting position of the digger and method by which it is powered.

   a. ______________________

   b. ______________________

4. List the two parts of the digger that permit it to operate up and down.

   a. ______________________

   b. ______________________

Topic Test
on
CROP DRYING EQUIPMENT

Student: ______________________ School: ______________________

Date: ______________________ Score: ______________________

It will be necessary for the teacher to develop questions from the operator's manual which the student has studied.

The following will serve as an example:
What is the purpose of a crop dryer?

True or False:

_____ 1. Hay dryers cannot be constructed on the farm.

_____ 2. The best method to dry baled hay is to force air through it in the barn.

_____ 3. Batch dryers are considered mobile.

_____ 4. The heat exchanger is the main part of a dryer.

_____ 5. When using a direct type heat exchanger the flame and gases flow around tubes and pass out through a special vent.

_____ 7. The batch dryer is available as a tower dryer.

_____ 8. Drying of grains and hays is really not considered a marketing requirement.

Topic Test
on
FORAGE BLOWERS

Student: ____________________ School: ____________________

Date: ____________________ Score: ____________________

It will be necessary for the teacher to develop questions from the operator's manual which the student has studied.

The following will serve as an example:
List the reason and remedy for the blower taking too much power.

True or False:

_____ 1. There is no one best speed to operate a blower.

_____ 2. On a PTO-driven machine, the over-running clutch permits the blower to clean out the forage.

_____ 3. It is not important that the paddles operate near the housing.

_____ 4. The blower discharge pipe is usually about 12 inches in diameter.

_____ 5. The spout is straight and can only be set in one position.

_____ 6. The chopping rotor operates in the same direction as the blower fan.

_____ 7. The blower is considered a separate unit on most machines.

Topic Test
on
TRACTOR-MOUNTED LOADERS

Student: ______________________ School: ______________________

Date: ______________________ Score: ______________________

It will be necessary for the teacher to develop questions from the operator's manual which the student has studied.

The following will serve as an example:

A farm loader has this problem: The load drops or settles. List the probable causes and remedies.

Answer the following questions:

1. List the two types of loaders.

   a. ______________________

   b. ______________________

2. Define lifting and carrying capacity.

   a. ______________________

   b. ______________________

3. List the two cycles that are used to measure the speed of the bucket.

   a. ______________________

   b. ______________________

4. Name two different types of loader units.

   a. ______________________

   b. ______________________

Topic Test
on
CHAIN SAWS

Student: ____________________ School: ____________________

Date: ____________________ Score: ____________________

It will be necessary for the teacher to develop questions from the operator's manual which the student has studied.

The following will serve as an example:
The chain stretches: List by steps the procedure in adjusting the chain.

PART I: Fill in the following blanks to make true complete statements:

1. The chain saw is lubricated by a ______________ mixture.
2. There are __________ events that take place in a two-cycle engine.
3. Most chain saws sold are ______________ drive.
4. The safe operating range of direct drive saws is _________ to _________ RPM.
5. The chain saw has an ____________ ______________ engine.

PART II: Place a T beside the statements that are true and an F by the statements that are false.

_____ 1. The power source of a chain saw is similar to the power source of an engine type lawn mower.

_____ 2. In a two cycle engine two strokes take place in one complete revolution.

_____ 3. The fuel-oil mixture enters the combustion chamber on the downward movement of the piston.

_____ 4. The most popular chain saw is gear drive.

_____ 5. Most chain saws use a centrifugal-type clutch,

Topic Test
on
FEED DISTRIBUTION EQUIPMENT

Student: ____________________ School: ____________________

Date: ____________________ Score: ____________________

It will be necessary for the teacher to develop questions from the operator's manual which the student has studied.

The following will serve as an example:
Make a list of points or places that should be checked daily on the feed distribution unit.

Answer the following questions:

1. List the bunk-type feed distributors found in feeding operations.

a. ____________________ e. ____________________

b. ____________________ f. ____________________

c. ____________________ g. ____________________

d. ____________________

2. List the two types of proportional-drop-auger units.

a. ____________________

b. ____________________

3. Give the functions of a bunk-feeder wagon.

a. ____________________

b. ____________________

4. Give the main purpose of using a tapered-bed chain conveyor unit.

a. ____

UNIT: Special Equipment
TOPIC: Feed Distribution Equipment
(Topic Test continued)

5. List two main features of the open bottom auger unit.

   a. ______________________________

   b. ______________________________

6. List the disadvantages of using a shaker trough unit.

   a. ______________________________

   b. ______________________________

Answer Sheet for Topic Test
on
THE MACHINERY INDUSTRY AND ITS IMPORTANCE IN AMERICAN AGRICULTURE

PART I:

1. a. 1797
   b. 1839
   c. 1863
   d. 1880
   e. 1850
   f. 1901 and 1918
   g. 1930's

PART II:

1. F
2. F
3. F
4. T
5. T
6. F
7. F
8. T
9. T
10. F
11. T
12. F
13. F
14. T
15. F

Answer Sheet for Topic Test
on
AGRICULTURAL MECHANICS AS AN OCCUPATION

1. a. Service supervisor or manager
   b. Mechanic or repairman
   c. Set-up man
   d. Mechanic's or repairman's helper
   e. Deliveryman

2. a. 80,000
   b. 955
   c. $450,000

3. a. Replace or repair damaged parts
   b. Heating and tempering metal
   c. Drilling metal
   d. Grinding metal
   e. Bending metal

4. a. Combines
   b. Planters
   c. Bailing equipment
   d. Cotton pickers
   e. Forage harvesters
   f. Sprayers
   g. Plows

5. a. Mechanical aptitude
   b. Interest
   c. Education

Answer Sheet for Topic Test
on
SAFETY - SHOP AND EQUIPMENT

PART I:

1. 86 to 88
2. Employee
3. 290,000
4. Clean
5. Respirator
6. Goggles
7. Thoughtlessness
8. Power
9. Live
10. Operator's Manual

PART II:

1. F
2. F
3. T
4. F
5. T
6. F
7. T
8. F
9. T
10. F

Answer Sheet for Topic Test
on
MECHANICAL TOOLS - IDENTIFICATION AND USE

PART I:

1. Outside
2. Thimble and barrel
3. Millimeter and thousandths
4. .025
5. Thimble
6. 352
7. Two
8. Thousandths
9. Circles and surface
10. Inside and outside

PART II:

1. T
2. F
3. F
4. T
5. F
6. T
7. F
8. F
9. F
10. T

Answer Sheet for Topic Test
on
USE OF HOLDING DEVICES, JACKS, LIFTS, AND HYDRAULIC PRESSES

1. T
2. T
3. F
4. F
5. F
6. T
7. T
8. F
9. F
10. T
11. F
12. F
13. F
14. T
15. F

Answer Sheet for Topic Test
on
USE OF EQUIPMENT MANUALS

1. T
2. F
3. F
4. F
5. F
6. T
7. T
8. T
9. F
10. T
11. T
12. T
13. F
14. T
15. F

Answer Sheet for Topic Test
on
EQUIPMENT INSPECTION

PART I:

1. F
2. F
3. T
4. F
5. T
6. F
7. T
8. F
9. F
10. F

PART II:

1. Disk
2. Planters
3. Cultivators
4. Hay baler
5. Hay balers
6. Mower
7. Rotary
8. Combine
9. Fertilizer
10. Warranty

Answer Sheet for Topic Test
on
FASTENERS USED ON EQUIPMENT

PART I:

1. a. Machine
   b. Stove
   c. Carriage
   d. Steel stud
   e. Hanger

2. a. Square
   b. Hexagon
   c. Hexagon jam
   d. Cap
   e. Slotted
   f. Castellated & Cotter pin
   g. Wing
   h. Speed
   i. Self Lock

PART II:

1. Lock washers
2. Spring steel stalock fasteners
3. Spring steel lock nut and palnut

PART III:

1. Slotted
2. Allen
3. Phillips
4. Reed-Prince
5. Spline
6. Clutch head
7. Sheet metal
8. Rivet
9. Snap ring
10. Set screw

Answer Sheet for Topic Test
on
THE FUNCTION AND TYPES OF BEARINGS USED ON EQUIPMENT

1. F
2. F
3. T
4. F
5. T
6. T
7. F
8. F
9. F
10. T
11. F
12. F
13. T
14. T
15. F
16. T

Answer Sheet for Topic Test
for
GASKETS, SEALS, AND SEALANTS FOR FARM EQUIPMENT

1. T
2. F
3. T
4. F
5. T
6. T
7. T
8. F
9. F
10. T
11. T
12. T
13. F
14. F
15. T
16. T
17. T

Answer Sheet for Topic Test
on
PAINTING EQUIPMENT AND MACHINES

1. Paint protects metal surfaces against corrosion and wear, adds to general appearance, and helps maintain the value.

2. Small parts are usually washed in a parts washer. A cleaning solution is used in the washer.

3. Clean water is used to rinse the parts after they have been removed from the alkaline bath.

4. Solvents dissolve grease and oil films on equipment parts.

5. Equipment parts are placed in a container or basket and lowered into a cleaning solution vat. After a specified amount of time they are removed and washed with water.

6. Paint is removed by treating the surface wth a caustic compound or other paint removing solvent or by burning off with a blow torch. After the paint is loose it is removed with a scraper, wire brush, and emery cloth.

7. Spray painting takes less time to cover a given area than is required when using a brush.

Answer Sheet for Topic Test
on
IMPORTANCE OF WELDING AND IDENTIFICATION OF METALS

1. Oxyacetylene
2. Electric, air
3. Gaseous smoke screen
4. Mild steel
5. 80 - 110
6. One-sixteenth inch
7. Beveled
8. Cast
9. Oxidizes
10. Thin steel
11. Bronze
12. Bronze
13. Hard surface
14. Flat
15. Beveled

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Page 11

Answer Sheet for Topic Test
on
TIRES AND WHEEL RIMS

1. T
2. T
3. F
4. T
5. T
6. F
7. F
8. F
9. F
10. T
11. T
12. T
13. T
14. F
15. F
16. F
17. T

Answer Sheet for Topic Test
on
TUBING AND HOSES

1. Hydraulic
2. Fluids, gases, and air
3. Steel and copper
4. Copper
5. Plastic
6. Aluminum
7. 37 or 45
8. Compressed
9. Pipe
10. Rubber
11. Hydraulic
12. 4000
13. 1125
14. Fabric and wire
15. Sleeve

Answer Sheet for Test on MOLDBOARD PLOWS

Part I:

1. Beam
2. Moldboard
3. Wing of share
4. Share
5. Cutting edge of share
6. Point of share
7. Gunnel of share
8. Shin
9. Landside
10. Landside heel reinforcement
11. Brace
12. Frog

Part II:

1. Furrow
2. Frog
3. Share
4. Land
5. Dead furrow

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Page 7

Answer Sheet for Test on DISK PLOWS

1. a. Moldboard
   b. Hoe
   c. Disk

2. a. Direct-mounted
   b. Semi-mounted
   c. Trailing

3. a. Disk blades
   b. Standards and clamps
   c. Bearings
   d. Beams and frames
   e. Lifting and steering mechanism
   f. Wheels

4. a. Cutting angle adjustment
   b. Width-of-cut adjustment
   c. Vertical adjustment of the disk blade

Answer Sheet for Test
on
MIDDLEBUSTERS AND LISTERS

1. a. Safety friction release
   b. Moldboards
   c. Frog or footpiece
   d. Share wings
   e. Replaceable point
2. a. Planters
   b. Damming attachment
   c. Automatic trips
   d. Colters
   e. Sweeps
3. By the number of bottoms
4. a. Trailing
   b. Mounted

Answer Sheet for Test
on
ROTARY PLOWS

1. a. Pull auxiliary-engine
   b. Pull power-take-off driven
   c. Self-propelled garden type

2. 4-, 5-, and 6-foot
   60 to 90 h.p.

3. 300 r.p.m.

4. 9 to 30 inches
   6 to 16 h.p.

Answer Sheet for Test on CHISEL PLOWS AND SUBSOILERS

1. T
2. F
3. F
4. T
5. F
6. F
7. T
8. T
9. T
10. F

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Answer Sheet for Test on DISK HARROWS

1. Penetration
2. Angling
3. Gang
4. Regular, offset
5. Plain, notched
6. Maple
7. Vertical adjustment devices
8. Bearings
9. Scrapers

Answer Sheet for Test
on
SPRING-TOOTH HARROWS

1. T
2. T
3. F
4. F
5. T
6. T
7. T
8. F
9. T
10. T

Answer Sheet for Test
on
SPIKE-TOOTH HARROWS

1. T
2. F
3. T
4. T
5. T

Answer Sheet for Test
on
LAND ROLLERS AND PULVERIZERS

1. Single
   Double

2. a. Roller-packer
   b. Pulverizers
   c. Mulcher

3. To crush lumps of soil and compact the soil after plowing or harrowing to form a firm seedbed

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Answer Sheet for Test
on
ROTARY HOES

1. Whitecast iron, which is an extremely hard metal

2. Not less than four and one-half miles per hour

3. No, except in harder soils.

4. This helps to reduce override of the tractor by the hoes or on downhill slopes.

5. They can be replaced by sections.

Answer Sheet for Test on GRAIN DRILLS

1. T
2. F
3. T
4. F
5. T
6. T
7. F
8. T
9. T
10. F

Answer Sheet for Test
on
ROW-CROP PLANTERS

1. a. Regular drill planter
   b. Checkrow planter

2. a. Soil tilth
   b. Soil moisture
   c. Kind of seed
   d. Local practices

3. Any three of the following:
   a. Curved runner
   b. Fully curved runner
   c. Stub runner
   d. Shovel opener
   e. Single-disk opener
   f. Curved double-disk opener

4. Any five of the following:
   a. Open-center press wheel
   b. Rubber-tired press wheel
   c Zero pressure rubber tire
   d. Disk coverers
   e. Blade coverers
   f. Shovels
   g. Knife blade

5. The purpose of markers is to form distinct guidelines that can be followed so that row width and straightness can be constant.

Answer Sheet for Test
on
INTRODUCTION

1. T
2. T
3. F
4. F
5. T

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Answer Sheet for Test
on
CULTIVATORS

1. Cultivation is an operation that requires some kind of tool that will stir the surface of the soil to a shallow depth in such a manner that young weeds will be destroyed and crop growth promoted.

2. a. Sweeps
   b. Shovels
   c. Spikes
   d. Disks
   e. Knives and hoes
   f. Furrowers

3. a. Blackland
   b. Mixed-land

4. Any three of the following:
   a. Rotary hoe
   b. Rotary shield
   c. Disk tillers
   d. Fertilizer attachments
   e. Seeders
   f. Ammonia applicators
   g. Nitrogen applicators
   h. Weeder-mulchers
   i. Row-crop thinners

Answer Sheet for Test
on
FLAME WEEDERS

1. T

2. F

3. F

4. F

5. T

Answer Sheet for Test
on
ROTARY SHREDDERS

1. a. Cuts
   b. Shatters
   c. Feathers
   d. Tears
   e. Chops
   f. Pulverizes

2. a. Driving mechanism
   b. Frame and cover
   c. Blades
   d. Gear box
   e. Wheels

3. a. Trailing
   b. Mounted

4. Parallel

Answer Sheet for Test
on
HYDRAULIC SPRAYERS

1. a. Reciprocating
   b. Rotary
   c. Diaphragm

2. a. Hollow cone
   b. Solid cone
   c. Flat-fan

3. Displacement

Answer Sheet for Test
on
PUMPS FOR AGRICULTURE SPRAYERS

1. a. Piston
   b. Gear
   c. Roller impeller
   d. Diaphragm
   e. Internal gear
   f. Centrifugal

Answer Sheet for Test
on
BLOWER SPRAYERS

1. T
2. F
3. T
4. F
5. F

Answer Sheet for Test
on
DUSTERS

1. Refer to sketch in workbook.

Answer Sheet for Test
on
CALIBRATING SPRAY EQUIPMENT

1. T

2. T

3. T

4. T

Answer Sheet for Test
on
MANURE SPREADERS

1. Driving

2. 1 to 2 inches

3. Any of these:
    a. Number of animals
    b. Hauling distance to fields
    c. Hilly conditions
    d. Traction
    e. Softness of soil

4. Conveyor

5. Roller

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Answer Sheet for Test
on
DRY FERTILIZER DISTRIBUTORS

1. T
2. T
3. F
4. F
5. T
6. T
7. F
8. T
9. T
10. T

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Answer Sheet for Test
on
LIQUID AND GAS FERTILIZER EQUIPMENT

1. T
2. F
3. T
4. T
5. T

Answer Sheet for Test
on
INTRODUCTION

11	Chaffer	4	Feeder
12	Grain trough	15	Cleaning fan
5	Cylinder	2	Knife
3	Platform auger	6	Concave grates
7	Cylinder beater	8	Finger grate
16	Tailings auger	9	Straw rack
14	Grain auger	13	Shoe sieve
1	Reel	10	Cylinder beater check flap

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Page 8

Answer Sheet for Test
on
CUTTING, FEEDING, AND THRESHING MECHANISMS

PART I:

1. Reel
2. Cutter bar
3. Feeding auger
4. Feeding conveyor
5. Cylinder
6. Concave
7. Cylinder beater

PART II:

1. T
2. F
3. T
4. T
5. F
6. F
7. T

Answer Sheet for Test
on
SEPARATING AND CLEANING MECHANISMS

PART I:

8. Concave
9. Straw rack
10. Deflector
11. Grain conveyor
12. Grain pan
13. Adjustable chaffer
14. Adjustable chaffer extension
15. Sieve
16. Fan
17. Windboard
18. Clean grain auger
19. Tailings auger
20. Tailboard

PART II:

1. T
2. F
3. F
4. T
5. F
6. T
7. T

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Page 5

Answer Sheet for Test
on
GRAIN HANDLING UNIT AND COMBINE ATTACHMENTS

PART I:

1. T
2. T
3. F
4. T
5. T

PART II:

1. Corn head attachment
2. Scourkleen
3. Wheels
4. Grain
5. Power-take-off

Vocational Instructional Services
Agricultural Education

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Answer Sheet for Test
for
INTRODUCTION TO CORN PICKERS

1. a. Corn snapper
   b. Corn picker
   c. Corn picker-sheller

2. a. Pull-type
   b. Tractor-mounted
   c. Self-propelled

3. a. Gathering mechanism
   b. Snapping mechanism
   c. Husking mechanism
   d. Cleaning mechanism
   e. Shelling mechanism

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Answer Sheet for Test
on
GATHERING AND SNAPPING MECHANISMS

1. T
2. T
3. F
4. F
5. F
6. T
7. T
8. T
9. F
10. T

Answer Sheet for Test
on
HUSKING, CLEANING, AND SHELLING MECHANISMS

1. F
2. T
3. T
4. T
5. T
6. T
7. T
8. T
9. T

Answer Sheet for Test
on
STRIPPERS

PART I:

1. Mounted
   Trailing
2. One-row
   Two-row
3. Roll strippers
   Finger strippers
4. Gathering
   Cleaning and conveying
5. Steel

PART II:

1. F
2. T
3. T
4. F
5. T

Answer Sheet for Test
on
PICKERS

PART I:

1. Picking spindle
2. Moistening pad
3. Air lift pipe
4. Pressure plates
5. Trash vent
6. Cam track
7. Doffer
8. Air intake

PART II:

1. 40
2. One
   Two
3. Drum
   Chain belt
4. Air
5. Doffers

Answer Sheet for Test
on
MOWERS

1. F
2. T
3. T
4. T
5. F
6. T
7. T
8. T
9. F
10. T

Answer Sheet for Test
on
HAY RAKES

PART I:

1. Side-delivery
2. Conventional reel rake
   Side-stroke rake
3. Power take-off
   Traction
4. Front
   Rear
5. Hydraulic

PART II:

1. T
2. T
3. T
4. T
5. T

Answer Sheet for Test
on
HAY CONDITIONERS

1. T
2. F
3. T
4. T
5. T

Answer Sheet for Test
on
WINDROWERS

1. a. Trailing
   b. Self-propelled

2. a. Trailing -- power take-off from tractor
   b. Self-propelled -- contains its own power source

3. a. Cuts
   b. Windrows
   c. Conditions

4. a. Mower
   b. Rake
   c. Conditioner

5. One tractor
   One operator

Answer Sheet for Test
on
BALERS

PART I:

1. T
2. T
3. F
4. F
5. F
6. T
7. T
8. T
9. T
10. F

PART II:

1. a. Pickup
   b. Feeding
   c. Compressing

2. By bales per minute or tons per hour

Answer Sheet for Test
on
FORAGE HARVESTERS

PART I:

1. a. Tractor-drawn
   b. Tractor-mounted
   c. Self-propelled

2. a. Cutting and feeding
   b. Chopping
   c. Blowing

3. a. Flywheel
   b. Cylinder

PART II:

1. T

2. F

3. T

4. T

5. T

Answer Sheet for Test
on
FARM ELEVATORS

1. Portable
   Stationary
2. a. Chain drag-flight
   b. Auger
   c. Blower
3. Blower
4. a. Trapezoidal-shaped
   b. Rectangular-folding

Answer Sheet for Test
on
FEED MILLS

1. T
2. F
3. F
4. T
5. T
6. T
7. F
8. T
9. T
10. F

Answer Sheet for Test
on
FEED GRINDER-MIXERS

Answer to Example:

1. Possible causes:
   a. Auger feeder speed too low
   b. Auger feeder at too steep an angle
2. Remedies
   a. Increase speed of auger feeder
   b. Raise auger feeder

Answers to teacher-made test:

1.

2.

3.

4.

5.

Answer Sheet for Test on POST-HOLE DIGGERS

1. a. Dig post holes
   b. Dig holes for concrete piers

2. a. 3-1/2 feet
   b. 4 to 12 inches

3. a. Front-end
   b. Power take-off

4. a. Telescoping drive shaft
   b. Universal joints

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Answer Sheet for Test on CROP DRYING EQUIPMENT

1. F
2. F
3. T
4. T
5. F
6. T
7. F
8. F

Answer Sheet for Test
on
FORAGE BLOWERS

1. F
2. T
3. F
4. F
5. F
6. T
7. T

Answer Sheet for Test
on
TRACTOR-MOUNTED LOADERS

1. a. Front-mounted
   b. Rear-mounted

2. a. Lifting capacity - Lift a maximum loaded bucket to the full height of the loader
   b. Carrying capacity - Carrying weight of material in the bucket, with the bucket three feet from the ground

3. a. Cycle time up
   b. Cycle time down

4. a. Manure loader
   b. Hay stacker

Answer Sheet for Test
on
CHAIN SAWS

PART I:		PART II:	
1.	Fuel-oil	1.	T
2.	Five	2.	T
3.	Direct	3.	F
4.	6,000 to 9,000	4.	T
5.	Internal combustion	5.	T

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Answer Sheet for Test
on
FEED DISTRIBUTION EQUIPMENT

1. a. Proportional drop auger
   b. Revolving-tube auger
   c. Swinging conveyors
   d. Tapered-bed chain conveyor
   e. Shaker trough
   f. Open bottom auger
   g. Bunk-feeder wagon

2. a. Holes or slots on sides
   b. Partly open side

3. a. Transport feed
   b. Mix feed
   c. Unload feed

4. Pull silage or other feed over the conveyor

5. a. Least expensive to purchase
   b. Most expensive to operate

6. a. Handles bales of hay or ground feed, but crowding may develop at feed inlet end.
   b. The bunk, drive, and suspension systems are expensive.